MONITOR

MONITOR HEATING SYSTEMS
Service Manual

M2400

M2200

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Monitor Products, Inc.
7A & 7E Marlen Drive
Robbinsville, NJ 08691

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1-1 SPECIFICATIONS

Model	Monitor 2400
Fuel Type	Crystal Clear Kerosene
Heater Efficiency	93%*
Heat Rating	High : 43,000 BTU/hour H.Medium : 32,000 BTU/hour L.Medium : 24,600 BTU/hour Low : 16,200 BTU/hour
Heater Output	High : 37,200 BTU/hour H.Medium : 26,900 BTU/hour L.Medium : 20,700 BTU/hour Low : 13,600 BTU/hour
Fuel Tank	Separate (Not supplied with heater)
Fuel Consumption	High : 0.319 Gallon/hour H.Medium : 0.24 Gallon/hour L.Medium : 0.18 Gallon/hour Low : 0.12 Gallon/hour
Power Source	120 Volts AC ; 60Hz
Power Consumption	Ignition : 310 Watts High combustion Operation : 68 Watts(Average) High to Low 4 steps combustion : 56.5 Watts(Average) Operations
Heated Air Delivery	High : 388 Cubic feet/minute H.Medium : 388 Cubic feet/minute L.Medium : 330 Cubic feet/minute Low : 300 Cubic feet/minute
Vent Pipe Hole	2½-inches Diameter
Dimensions	Height : 26.6 inches Width : 28.7 inches Depth : 14.0 inches
Weight	82 Pounds, empty

* Net Efficiency is 88%, A.F.U.E. is 84%

1-2 SPECIAL FEATURES

AUTOMATIC IGNITION

MEMORY BACK UP : Set Memory can be kept in case of power failure for up to 30 minutes.

DUAL BLOWERS : Separate fans for combustion and room air circulation.

THERMOSTATICALLY CONTROLLED : Adjusts to the desired room temperature.

BUILT-IN TIMER : Heater will automatically operate as programmed by the user.

AUTOMATIC RESET AFTER POWER FAILURE : Heater will automatically resume operation after power is restored.

INDICATOR LIGHTS : Easy-to-see signals show when heater is in operation, when timer is activated, and when the burner is operating.

CHOICE OF FUEL SUPPLY : Connect to separate tank.

MULTIPLE HEAT EXCHANGER : Extracts 88% of heat from burner.

CLEAN OPERATION : Products of combustion are vented outside.

CONSUMES NO ROOM AIR : Air for combustion is drawn from outside.

EASY INSTALLATION : Includes all parts required for standard installation.

CHILD LOCK : Prevents accidental operation and prevents small children from altering the controls.

1-3 SAFETY FEATURES

SAFE RE-LIGHTING : Heater will not restart until its combustion chamber has cooled.

ELECTRICAL PROTECTION : Heater automatically shuts off in the unlikely event of a malfunction in the electrical circuitry or disruption of the power supply.

NO EXHAUST IN ROOM : Products of combustion are discharged outdoors.

FLUE PIPE : Outside air is drawn through a pipe-within-a-pipe venting system. This process preheats combustion air and regains heat from exhaust gases.

⚠CAUTION:ALTERNATE POWER SOURCES

The Monitor 2400 may not operate when powered by sources such as an auxiliary generator, UPS (Uninterrupted Power Source), inverters, etc. Check with your dealer for guidance on specific applications.

1-4 SPECIFICATIONS

Model	Monitor 2200
Fuel Type	Red dyed or Clear Kerosene or Low Sulphur #1 Oil
Heater Efficiency	93%*
Heat Rating	High : 22,000 BTU/hour H.Medium : 17,400 BTU/hour L.Medium : 12,400 BTU/hour Low : 9,600 BTU/hour
Heater Output	High : 18,260 BTU/hour H.Medium : 14,440 BTU/hour L.Medium : 10,290 BTU/hour Low : 7,970 BTU/hour
Fuel Tank	Separate (Capsule tank optional)
Fuel Consumption	High : 0.164 Gallon/hour H.Medium : 0.13 Gallon/hour L.Medium : 0.19 Gallon/hour Low : 0.07 Gallon/hour
Power Source	120 Volts AC ; 60Hz
Power Consumption	Ignition : 250 Watts Operations : 41Watts (Average)
Heated Air Delivery	High : 176 Cubic feet/minute H.Medium : 176 Cubic feet/minute L.Medium : 126 Cubic feet/minute Low : 113 Cubic feet/minute
Vent Pipe Hole	2½-inches Diameter
Dimensions	Height : 26.0 inches Width : 20.9 inches Depth : 13.0 inches
Weight	55 Pounds, empty

* When considering heat of condensation is lost, then the net efficiency is 88%, A.F.U.E. is 84%

1-5 SPECIAL FEATURES

AUTOMATIC IGNITION

MEMORY BACK UP : Set Memory can be kept in case of power failure for up to 30 minutes.

DUAL BLOWERS : Separate fans for combustion and room air circulation.

THERMOSTATICALLY CONTROLLED : Adjusts to the desired room temperature.

BUILT-IN TIMER : Heater will automatically operate as programmed by the user.

AUTOMATIC RESET AFTER POWER FAILURE : Heater will automatically resume operation after power is restored.

INDICATOR LIGHTS : Easy-to-see signals show when heater is in operation, when timer is activated, and when the burner is operating.

CHOICE OF FUEL SUPPLY : Connect to separate tank or capsule tank optional.

MULTIPLE HEAT EXCHANGER : Extracts 88% of heat from burner.

CLEAN OPERATION : Products of combustion are vented outside.

CONSUMES NO ROOM AIR : Air for combustion is drawn from outside.

EASY INSTALLATION : Includes all parts required for standard installation.

CHILD LOCK : Prevents accidental operation and prevents small children from altering the controls.

1-6 SAFETY FEATURES

SAFE RE-LIGHTING : Heater will not restart until its combustion chamber has cooled.

ELECTRICAL PROTECTION : Heater automatically shuts off in the unlikely event of a malfunction in the electrical circuitry or disruption of the power supply.

NO EXHAUST IN ROOM : Products of combustion are discharged outdoors.

FLUE PIPE : Outside air is drawn through a pipe-within-a-pipe venting system. This process preheats combustion air and regains heat from exhaust gases.

⚠CAUTION:ALTERNATE POWER SOURCES

The Monitor 2200 may not operate when powered by sources such as an auxiliary generator, UPS (Uninterrupted Power Source), inverters, etc. Check with your dealer for guidance on specific applications.

1-7 DESCRIPTION

The Monitor heaters are composed of the following: a spill tray, a cabinet, a combustion system, an air circulation system, a fuel delivery system, electrical and electronics systems and a variety of safety mechanisms.

1-8 SPILL TRAY

The Spill Tray:

— Protects the floor from damage resulting from fuel spillage.

— Provides a secure, tip-resistant heater base.

Metal retainers (2) secure the heater to the Spill Tray.

The legs are positioned with in the circular indentations.

1-9 HEATER CABINET

A steel cabinet holds and protects all internal components.

A number of primary parts are assembled to form this housing.

1-10 CMBUSTION SYSTEM

The Combustion System is responsible for the production of heat which is circulated into the room .

In the Combustion Systems a mixture of fuel and air is burned to produce heat. Air is drawn from outside the dwelling into the Combustion Chamber. At the same time, fuel is metered from a storage cavity into this same Combustion Chamber. Within the chamber, the air/fuel mixture is ignited to produce heat.

The Monitor combustion systems are safeguarded by a pair of overheat protector switches; They will shut down the heater (to protect it from damage) in the event of excessive heat build-up. The overheat protector switches reset automatically after cooling down.

1-11 COMBUSTION CHAMBER

This tall cylinder is positioned on the Heater Base. It is secured to the base by phillips head screws.

Connected to the Combustion Chamber are the igniter, (located within the chamber) a fuel line, the Heat Exchanger, and a Flame Sensor.

Within the Combustion Chamber are the Burner Pot, the Combustion Ring Assembly. Access to those internally-located parts is facilitated by a removable Service panel.

A Window on the panel lets the technician visually examine the combustion process(i.e. glowing igniter or proper flame color).

An airway, in the Cabinet Base, extends from the intake fan of the Combustion Blower to the hollow base of the Combustion Chamber. This airway channels air to the Combustion Chamber.

The Flame Sensor is mounted with two (2) phillips head screws onto the wall of the Combustion Chamber.

1-12 BURNER POT

Designed specifically to support combustion, the Burner Pot (refer to Figure 1-2/1-3) contains a series of air holes, an igniter tube (to accommodate the Igniter), and a fuel inlet fitting (interconnects the fuel line). It is secured to a mounting plate near the bottom of the Combustion Chamber.

The Combustion Ring Assembly is seated on three (3) screws or pins in the Burner Pot.

1-13 COMBUSTION RING ASSEMBLY

This assembly is a special structure, designed to promote efficient combustion.

1-14 FLAME SENSOR

Mounted on the outside wall of Combustion Chamber, the Flame Sensor always supervises the flame.

1-15 IGNITER

Located within the igniter tube of the Burner Pot, the Igniter is designed to pre-heat the Burner Pot and to vaporize and ignite the air/fuel mixture to start the combustion process.

The Igniter is secured by a bracket and screw to the igniter tube. The cover plate is secured to the combustion chamber by three (3) phillips head screws.

1-16 COMBUSTION AIR SYSTEM

The Combustion Air System channels air to and from the heater.

Outside air is drawn into the heater by the Combustion Blower through an airway to the Combustion Chamber.

A Combustion Blower draws the intake air in through a Flue Pipe. This air enters the Combustion Chamber at the Burner Pot and mixes with the fuel to support combustion, Remaining air is heated and is drawn into the Heat Exchanger.

As the heated air passes through the Heat Exchanger, an Air Circulation Fan blows room air past the Heat Exchanger and out again into the room, heating passing air by convection. Exhaust vapors exiting from the Heat Exchanger are vented through the Flue Pipe.

A deterioration of air pressure at the Air Pressure Switch is an abnormal condition; the heater is shut down by the malfunction.

1-17 FLUE PIPE

The Flue Pipes is adaptable in three (3) sizes. This provides the flexibility to meet the installation requirements for walls of various thicknesses.
The Flue Pipe is two Sections, Flue pipe A and Flue pipe B.

The Flue Pipe A contains a "T"-shaped fitting consisting of four ports. This side is mounted on the interior wall of the dwelling. The Flue Pipe B is vented outside the dwelling. The Flue Pipe Assembly consists of two concentric tubes. Outside air is drawn through the cylindrical space between the tubes.
Combustion by-products are vented through the inner tube.

As the cool air enters, it is heated by the hot air that is exiting the system.

A large-bore, flexible hose connects the air inlet port on the Flue Pipe A with the Combustion Blower; a cloth-covered metal pipe connects the Combustion Blower with the exhaust outlet on the Flue Pipe A.

IMPORTANT: If extension kits are utilized, use the correct damper in accordance with the instructions in table 2-1 of page 14

1-18 COMBUSTION BLOWER MOTOR

The combustion blower has a four stage intake fan Burner modes control fan speeds.
The combustion air controls are as follows:

Table 1-1 COMBUSTION AIR CONTROL (M-2400)

Burn Mode	Fan Speed (r.p.m.)
High	2,800
Medium-High	2,300
Medium-Low	1,900
Low	1,500

Please refer to paragraph 1-35 in page7 for the details of the combustion blower motor control.

1-19 HEAT EXCHANGER

An inlet at the top of the Heat Exchanger permits the heated air to travel from the Combustion Chamber into the exchanger.
An outlet, at the bottom of the exchanger, permits combustion by-products to be vented to the Flue Pipe.

While moving through the Heat Exchanger, the hot air within the exchanger heats the outside metal walls. The hot metal walls, in turn, heat air that is pushed past the exchanger and is circulated into the room. An air baffle, directly in front of the exchanger, deflects the heated air upwards, and out, through the louver assembly.

A pair of Over-Heat Protector Switches protect the heater from damage due to excessive heat built-up.

1-20 AIR CIRCULATION FAN

Circulation fans are driven by three-speed motors and are designed to circulate the heated room air.

If the heater is running in low burn modes, the fan also runs at low-speed; in medium-low burn mode, the fan runs at medium-speed; in medium-high or high burn modes, the fan advances to high speed.

Operation of the fan is controlled by the microprocessor and fan thermostat switch.
Physically assembled with a protective wire cage for the heater, the entire fan assembly is secured to a bracket on the rear of the Heater Cabinet.
A metal conduit, at the rear of the heater, protects the fan wiring from damage.

1-21 AIR PRESSURE SWITCH

This switch consists of a rubber diaphragm which senses changes in air pressure(it is connected to the Combustion Blower) and is a normally open, micro switch.

Should an abnormal pressure differential exist, the switch opens to disable the circuitry that controls the supply of fuel. Since the flow of fuel to the Burner Pot is cut off, the flame extinguishes (after all fuel currently in the line has been consumed), and the code ⌈E14⌋is indicated in the digital display.

This safety mechanism can be triggered by several conditions:
- — Leak or loose connection in air line
- — Leak, loose, or broken tubing which connects the Air Pressure Switch with the Combustion Blower
- — Clogged or blocked Air Line
- — Blocked or clogged Flue Pipe
- — Intake port Combustion Blower is blocked.
- — Combustion Blower is inoperable
- — Clogged or block air/intake hose.

1-22 FUEL DELIVERY SYSTEM

Fuel Delivery is a very important aspect of the Monitor's operation.

The fuel flow must be maintained at a level corresponding to the burn mode, so that combustion can be conducted efficiently.

Fuel moves by gravity-flow from the external fuel storage tank or the capsule fuel tank to the Fuel Constant Level Valve.

The Solenoid Pump meters the flow of fuel from the Fuel Constant Level Valve to the Burner Pot.

The metered flow of fuel is carried to the Burner Pot by a copper fuel line.

1-23 EXTERNAL FUEL TANK

Fuel for the Monitors can be stored in, and fed from an external storage tank. The tank, which generally is dealer installed, should contain a shutoff valve, a fuel filter and a vent. Installation of the tank should conform to local regulations and to the specifications and guidelines documented in this Service Manual.

1-24 FUSIBLE LINK VALVE

Basically, the Fusible Link Valve is a safety mechanism that cuts-off fuel to the heater in the event of an overheat condition at the valve.

In M-2400/M-2200, Fusible Link Valve is not installed, If necessary, it can be installed outside of the appliance.

The Fusible Link Valve is a springloaded device that cuts off the supply of fuel to the heater when the temperature level (at the valve)
exceeds a predefined maximum limit.

An inlet on the bottom of the valve allows fuel to pass into the heater. The handle-which can also manually be opened or closed-sits on a springloaded stem which contains a low-melting point alloy.

1-25 FUEL CONSTANT LEVEL VALVE

This valve has an automatic shutoff safety mechanism and a Fuel Set Lever. The safety mechanism prevents fuel from flooding or overflowing from the fuel reservoir. The Fuel Set Lever resets the float so the Fuel Constant Level Valve can resume operation.

The fuel reservoir is a tank which contains a float assembly, a safety mechanism, and a priming lever.

Fuel enters the Fuel Constant Level Valve through an inlet at the bottom of the reservoir. As the level of fuel rises, it passes through a filter (which removes most particles and foreign matter from the fuel), flows up through an open inlet valve and enters the tank.

IMPORTANT: The Fuel Constant Level Valve filter should be cleaned or replaced periodically. Time intervals will depend on purity and quality of fuel.

Within the Valve, a float mechanism controls the level of fuel that will be permitted to the reservoir. As the fuel level drops, the float drops down to increase the inlet valve opening to admit more fuel into the valve. When the fuel level reaches its maximum volume. the float rises to shut the inlet valve.

In the event that fuel within the reservoir rises to an abnormally high level, a float within the reservoir rises to trip a safety magnet. This safety magnet locks out the float to prevent fuel from entering in the reservoir.

Should a foreign substance cause the inlet valve to stick (or prevent it from opening), the Fuel Set Lever is utilized to free the valve and to admit fuel to the reservoir.

⚠CAUTION: Care must be taken to prevent dust, dirt, or other debris from clogging or blocking the inlet valve. If debris collects on the seat of the inlet valve it may cause tripping of the safety lever and will require cleaning.

1-26 SOLENOID PUMP

The Solenoid Pump, mounted on the Fuel Constant Level Valve, and controlled by a microprocessor, delivers four fuel flow modes (High, Medium-High, Medium-Low, Low) to the Burner Pot.

1-27 ELECTRICAL SYSTEM

Electrical power is supplied to the Monitor to run the Microprocessor and the other electrically-energized component.

Electrical operation of the Monitor can be thought of as having the following eight(8) distinct phases:plug in; turn-on; pre-purge/pre-heat; ignition; pre-combustion; heating; Shutdown and post-purge.

All electronic diagrams, Such as wiring diagram, circuit board layout, and electrical schematic can be found in Section 7 of this Service Manual.

1-28 MICROPROCESSOR

Principally consisting of a 64-pin Integrated Circuit, the Microprocessor provides safety timings, controls relays and provides clock and thermostat functions for the Monitor heater. A component layout of the Printed Circuit Board is found in Section 7 of this Service Manual.

1-29 TEMPERATURE SENSOR

The sensor which is capable of sensing room temperature within a range of 42°F to 96°F, can be left mounted on the back of the heater cabinet or be wall mounted.

Approximately 4½' (about 140 cm) of No. 22 AWG Wire is supplied with the sensor to facilitate wall mounting the sensor in a favorable location.

1-30 SAFETY MECHANISMS

Several safety mechanisms have been built into the Monitor Heating System. These devices protect the user against personal injury, protect the heater against damage, and shutdown the heater if a malfunction occurs.

1-31 CLOTH COVERED EXHAUST PIPE

Insulating cloth covers are to be placed over all metal surfaces of the Exhaust Line during installation.

Since combustion by-products are vented at elevated temperatures, the Exhaust Pipe will become hot during operation. The insulating cloth covers protect the user from burn hazards associated with accidental contact with these heated metal surfaces.

During installation make sure that all Exhaust Lines are tight. Do not operate the heater without the insulating covers.

1-32 AIR CIRCULATION FAN GUARD

This guard is an integral part of the fan assembly.

The guard protects the user against physical injury which could occur from accidental contact with revolving metal fan blade.

1-33 FUSE

2-amp. and 10-amp., 125VAC, fuses protect the heater from damage resulting from power overloads.

In the event of a power surge or internal wiring hazards, the fuse opens and power to the heater is cut off.

The electrical outlet into which the heater is connected should be protected by at least a 15-amp. fuse or circuit breaker.

1-34 OVERHEAT PROTECTOR SWITCHES (M-2400)

Connected in series, two (2) normally-closed Overheat Protector Switches safeguard the heaters against damage due to overheating.

The switches are rated 115°C (239°F). Should a Monitor overheat (internal temperatures rise beyond 115°C (239°F)). either or both switches will open to shut down the heater. After extinguishing the flame, the code [E14] is indicated in the digital display. The Overheat Protector Switches will automatically reset after cooling down.

Once the heater has cooled to 90°C (194°F), the system can be restarted. To restart the Monitor, proceed as follows:

A. Press ON/OFF Switch to OFF.
B. Allow heater to cool.
C. Troubleshoot the cause of the overheat.
D. Press ON/OFF switch to ON
E. Proceed with normal operation.

1-35 Revolution control of combustion blower motor

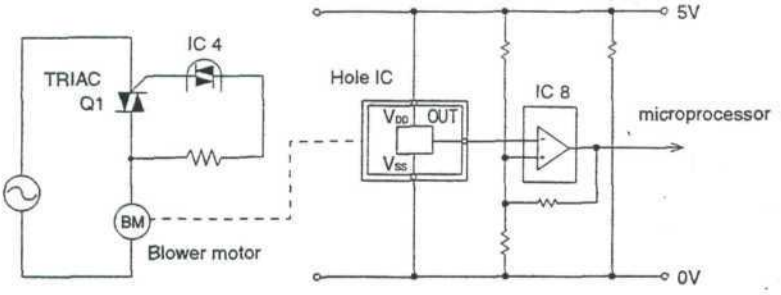


Fig. 1-1

As shown in Fig.1-1, the current-carrying ratio for the combustion blower motor shall be performed by the phase control, TRIAC, Q1.

The combustion blower motor has a built-in hole IC of which input signal is entered to the microprocessor through the comparator IC8.

The hole IC outputs the pulse signal by 6 pulse every one revolution of the motor. The microprocessor counts this pulse signal to obtain the number of pulse, frequency per one second, and then compute the motor revolution per one minute by this frequency.

In order to achieve the target control revolutions shown in Table 1-1/1-2, Page 4/8, the current-carrying ratio to the motor shall be controlled by TRIAC, Q1 to make the revolution of the combustion blower motor constant.

If the revolution of the combustion blower has slowed down to less than 1200 (rpm), an abnormal revolution will be sensed and then the heater operation will be stopped indicating the error code of (E08) in the display window.

1-36 COMBUSTION BLOWER MOTOR

The combustion blower has a four stage intake fan Burner modes control fan speeds.
The combustion air controls are as follows:

Table 1-2 COMBUSTION AIR CONTROL

Burn Mode	Fan Speed (r.p.m.)
High	2,975
Medium-High	2,550
Medium-Low	2,025
Low	1,800

1-37 OVERHEAT PROTECTOR SWITCHES

Connected in series, two (2) normally-closed Overheat Protector Switches safeguard the heaters against damage due to overheating.

The switches are rated 110°C (230°F) and 105°C (221°F). Should a Monitor overheat (internal temperatures rise beyond 105°C (221°F). either or both switches will open to shut down the heater. After extinguishing the flame, the code [E05] is indicated in the digital display. The Overheat Protector Switches will automatically reset after cooling down.

Once the heater has cooled to 90°C (194°F), the system can be restarted. To restart the Monitor, proceed as follows:

A. Press ON/OFF Switch to OFF.
B. Allow heater to cool.
C. Troubleshoot the cause of the overheat.
D. Press ON/OFF switch to ON
E. Proceed with normal operation.

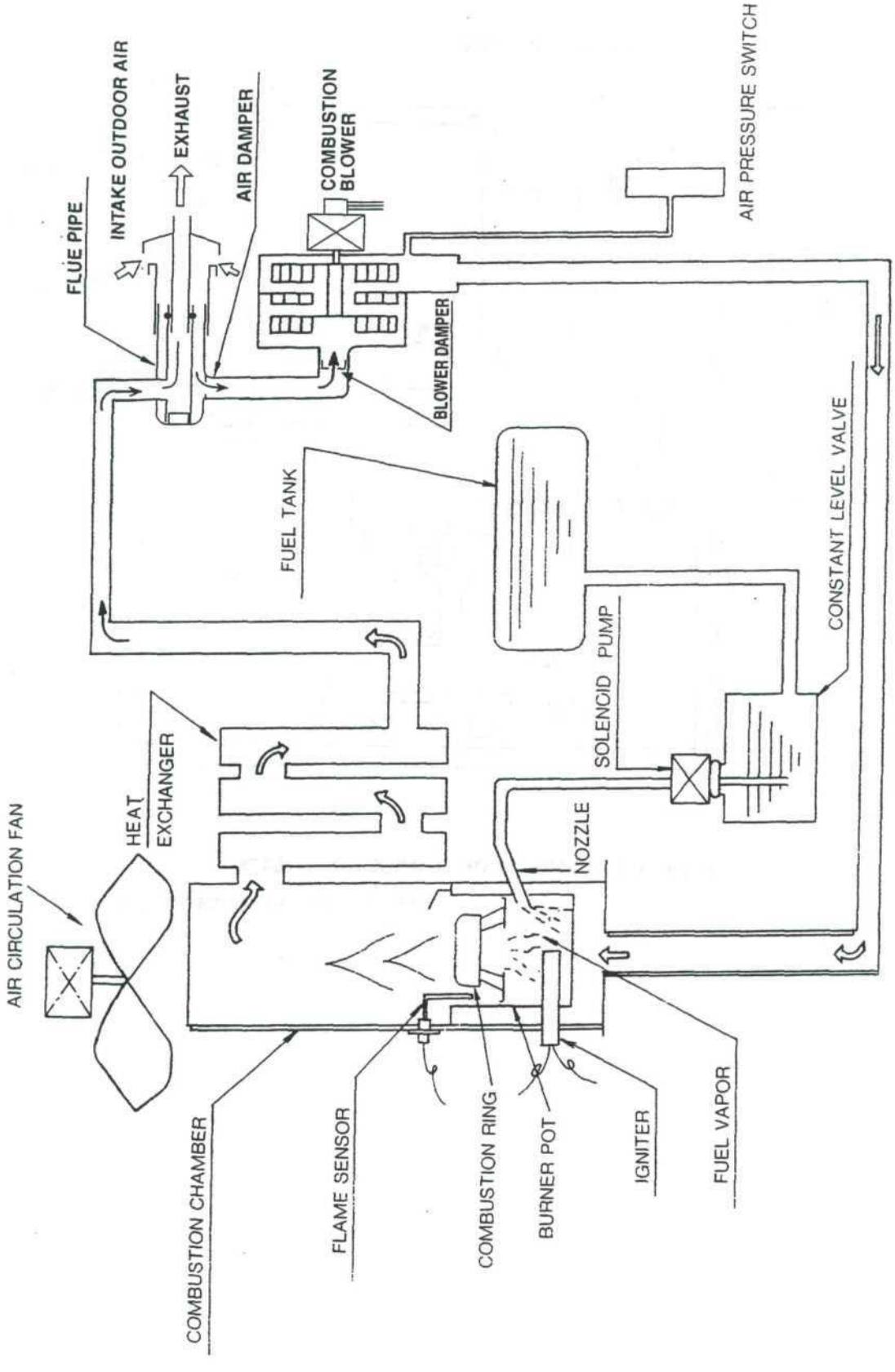


Figure 1-2 ELEMENTS OF COMBUSTION SYSTEM

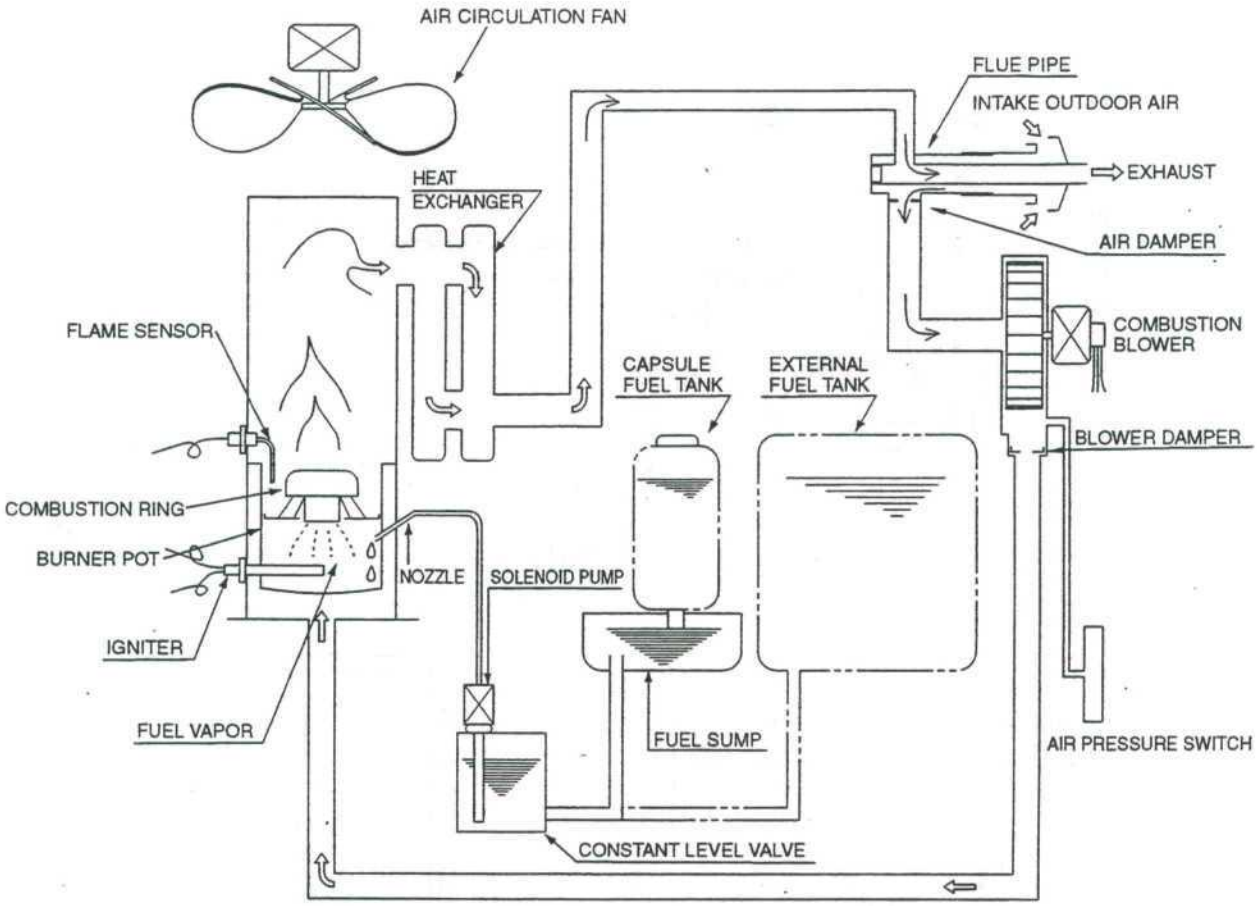


Figure 1-3 ELEMENTS OF COMBUSTION SYSTEM

NOTE: Capsule tank cannot be used in Connecticut.

2-1 INTRODUCTION

Installing the Monitor System at the user's location can be performed quickly and economically.

The Monitor 2400/2200 model is strictly a remotely fueled system and is externally vented. As such it needs the installation of an externally vented intake/exhaust system and if remotely fueled, will need the installation of a remote fuel storage tank.

By completing each step of the easy-to-follow installation instructions (each step should be completed in the exact order specified). the Technician is directed through the installation process.

This section contains all relevant installation information including:

— Installation specifications
— List of installation tools
— Alternative types of venting systems (and installation procedures for each)
— Basic requirements for fuel tank installation
— Instructions to install the Monitor System

IMPORTANT: Before beginning installation of the Monitor vented heating system (including any electrical wiring and fuel supply equipment), check local building,electrical, mechanical and fire codes. The requirements of these codes must be followed to insure lawful installation and use.

The heater can be located almost anywhere within the dwelling provided that electrical, fuel, and exhaust specifications are met.

2-2 PHYSICAL PLACEMENT OF HEATER

In addition to the space taken up by the heater, interior space must also be reserved for free air circulation. Remove all combustibles from the heating area.

Unless building or fire codes dictate otherwise, the Monitor system can be placed on any floor surface (including carpeting or other combustible material) and provide safe operation.

2-3 DRILLING REQUIREMENTS

Through-the-wall Flue Pipe installation requires that a 2 $^1/_2$″ (65mm) hole be drilled through the dwelling wall (interior to exterior). The hole must be pitched downward toward the outside at an approximate angle of 2°(about $^1/_2$″ per foot). The appropriate wall area (in which hole will be drilled) must contain no internal obstacles such as piping, wiring, air ducts, or studs.

RECOMMENDED TOOL KIT FOR MONITOR HEATER SERVICE TECHNICIANS

1) #2 Phillips Head Screwdriver
2) Steel Tape Measure
3) Felt Tip Pen or Pencil
4) Caulking Material (exterior grade)
5) Electrical Drill (reverse capability recommended)
6) Hole Saw, Saber (Jig) Saw, or other appropriate tool for cutting a 2.5″ diameter hole for flue pipe
7) Rubber Clipping Tool
8) Long Drill Bit—$^1/_2$″
9) #2 Standard Screwdriver
10) Adjustable Wrenches (various sizes)
11) Copper Tubing Cutter
12) Copper Tubing Flaring Tool
13) V.O.M.(Volt, OHM. Meter with shielded probes)
14) Level
15) Plumber's Pipe Thread Tape
16) Small assortment of Self-Tappeng Screws
17) Assorted Pliers (Slip Joint, Needlenose, Cutting, Lock Joint)
18) Phenolic Probe or Insulated Screwdriver
19) Supply of 125V, 2 and 10 Amp fuses
20) Floor mat to cover carpeting
21) Quart size pan for draining fuel

2-4 POWER REQUIREMENTS

⚠ WARNING:

THE MONITOR POWER CORD MUST BE PLUGGED INTO A DIRECTLY ACCESSIBLE WALL OUTLET. DO NOT USE AN EXTENSION CORD TO MAKE THIS ELECTRICAL CONNECTION.

Line current to the system should be 120 VAC at 60 Hz. The electrical system should be protected against current overload by means of at least a 15-ampere fuse or circuit breaker.

NOTE: The wall outlet should supply electricity for the Monitor system only. Do not connect any other electrical appliance to it.

⚠CAUTION: In some installations, it may be best to hard-wire the heater to the house circuits. A competent, licensed electrician should do this.

2-5 FUEL TANK REQUIREMENTS

⚠ WARNING:

INSTALLATION OF ANY REMOTELY LOCATED FUEL TANKS MUST COMPLY WITH ALL LOCAL STANDARDS AND/OR BUILDING CODES.

Heater fuel (crystal clear kerosene only) can be stored in remotely located storage tanks ranging from 55 gallon drums to 275 gallon tanks. When using large tanks a pressure regulator with a max. of 2.5 PSI should be installed near heater inlet.
(if top of tank is going to be 8' higher than base of unit.)

⚠CAUTION: In some installations, it may be better to install permanent fuel tank plumbing. A licensed plumber or oil dealer should do this.

2-6 TEMPERATURE SENSOR WIRING REQUIREMENTS

A wall-mounted temperature Sensor gauges room temperature and automatically regulates the heating cycles of the Monitor System.

The standard sensor wire is 4½' long and can be left mounted on the back of the cabinet as shipped. If this is not practical the sensor can be mounted on a wall.

⚠CAUTION: If sensor is to be mounted remotely be careful not to place it in direct sunlight, on uninsulated exterior walls in drafty areas etc., as this will create an inaccurate temperature reading.

2-7 BUILDING CODES

Fire regulations, electrical and other local building codes may govern the installation and use of a vented heater and related fueling systems. Prior to installation, check and comply with all codes.

2-8 UNPACKING

Save all shipping materials until the Monitor has been completely installed and is working properly.

A. Cut the three plastic ribbons that hold the shipping carton together.
B. Remove the top.
C. Remove from the shipping carton the Cardboard (drilling) Template and the Owner's Guide.

NOTE: The Dealer should complete the Registration Card at time of customer purchase and return it to Monitor Products, Inc. as soon as possible.

D. Remove the spill tray from shipping carton, and remove the plastic bag.
E. Remove the plastic bag covering the heater.
F. Remove the plastic bag containing the heater parts,and set it aside.
G. Remove the Flue Pipe from the rear of the heater. When ready to install, separate Flue Pipe from cardboard packing materials.
H. Firmly grasp cabinet handles (one of each side of heater cabinet) and lift heater off the cardboard shipping base.
I. Check for parts as listed in Monitor Owners Guide.

IMPORTANT: Only the standard-size Flue Pipe is shipped with the heater. The Monitor dealer will also stock a longer Flue pipe B and a Relay pipe, Window Kits, Extension Kits, and other accessories that may be required for non-standard installations.

2-9 HEATER INSTALLATION

In choosing a location for your heater, the following guidelines must be considered:

- The heater MAY be installed on combustible floors.
- The area around the heater should be free of obstacles that might interfere with the free flow of air. Allow the clearances shown in Figure 2-1.
- The heater must not be installed in a combustible fireplace.
- An AC wall outlet must be within reach of the heater's power cord. Extension cords must not be used.
- The area outside where the flue pipe will emerge should be free of foliage, fuel storage tanks and flammable objects. Air should circulate freely in the area. Allow the clearances shown on following page.
- The wall where flue pipe hole will be cut should be free of plumbing pipes, electrical wires, studs. air ducts and other obstacles.

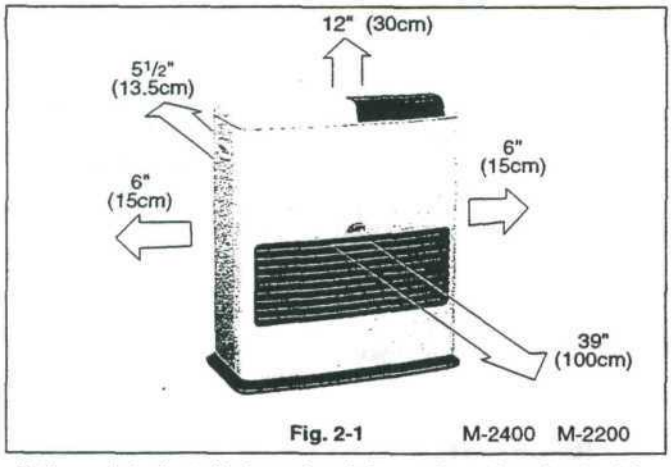


Fig. 2-1 M-2400 M-2200

If the unit is installed so that it is enclosed on both sides and top, the following instructions shall be carried out.

With the side and top clearances as shown in the illustration (Fig. 2-2) the front of the Monitor shall be placed so that the front surface protrudes 5 inches (12.5 cm) beyond the enclosure. (See Fig. 2-3)

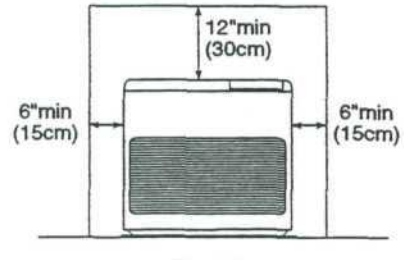


Fig. 2-2

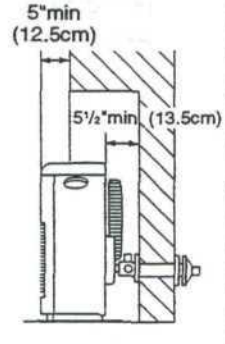
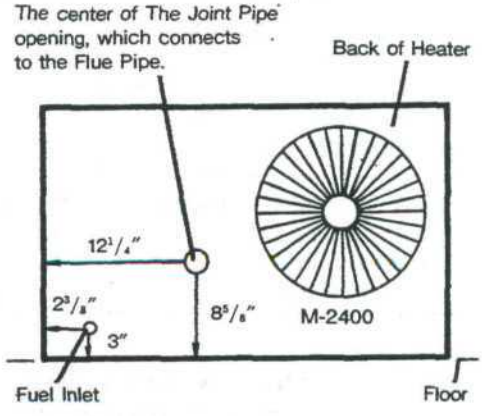


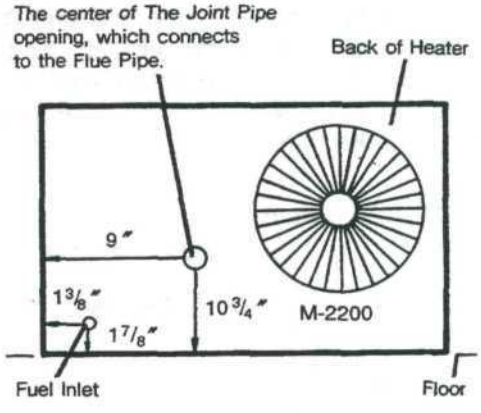
Fig. 2-3

M-2400

NOTE: *After using the installation template as a guide for drilling the flue pipe hole, the Monitor Flue Pipe can be normally installed according to the illustration procedure in the* Monitor Manual.

Just in case the template was misplaced, the approximate flue pipe hole location measurements are as follows:





With the side and top clearances as shown in Fig. 2-4, the Monitor shall not be placed so that its front surface is inside of the enclosure.

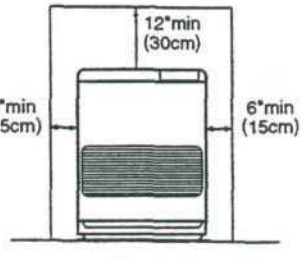


Fig. 2-4

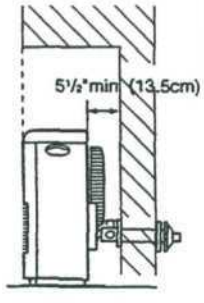


Fig. 2-5

M-2200

Table 2-1 Installation Classification for using Damper Diameter and Processing of P.W.B. Jumper Wire CJ

Installation Classification	Altitude (feet)					
	0~3,000		3,000~5,000		5,000~7,000	
	Air Damper	Blower Damper	Air Damper	Blower Damper	Air Damper	Blower Damper
Up to 1 bend(90°elbows) with no extension	STANDARD Used	Used	STANDARD Used	Used	EXTENSION Used	Used
Up to 1 bend(90°elbows) with extension kit length : 0-73"			Not Used	Used	Not Used	Not Used
2 bends with extension kit length : exceed 20" or 3 bends	EXTENSION Used	Used	Not Used	Not Used	THIS UNIT CAN NOT BE USED FOR THIS APPLICATION.	
P.W.B. Jumper Wire CJ	No Cut		Cut			

The blower damper is fixed with suction case B of the combustion blower ass'y, as shown in Fig. 2-6. To remove the blower damper from suction case B, remove the air hose supply ass'y, first and then loosen the screw holding the blower damper. After the blower damper has been removed, insert air supply hose ass'y into the suction case B and tighten by the hose band.

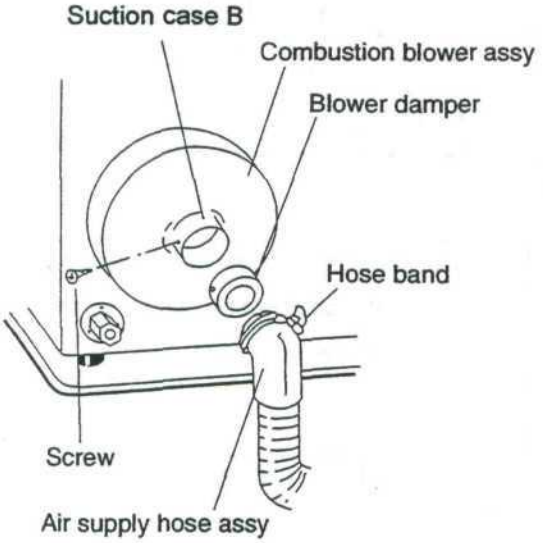
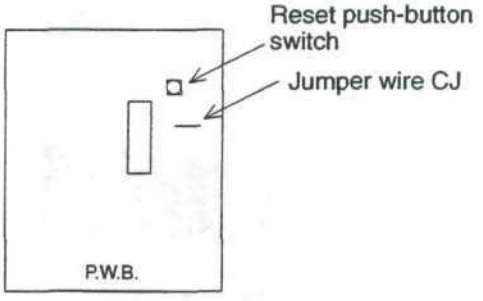


Fig. 2-6

[Position of P.W.B. jumper wire CJ and reset push-button switch]



IMPORTANT:
After cutting the jumper wire CJ, please be sure to press the reset push-button switch on the P.W.B. two to three times, with the power plug inserted in the socket.
If the reset button has been pressed, settings such as the current time, current day of the week, economy plus and child lock functions will be cancelled, and these programs must be set again.

Table 2-2 Installation Classification for using Damper Diameter and Processing of P.W.B. Jumper Wire CJ

Installation Classification NOTE: IT IS IMPORTANT TO USE THE CORRECT DAMPER SHOWN IN THIS TABLE.	Altitude		
	0~700m 0~2330 ft	700~1400m 2330~4660 ft	1400~2100m 4660~7000 ft
	Air Damper	Air Damper	Air Damper
Up to 1 bend (90°elbows) with Extension kit length of 0-73 in.	STANDARD USED	EXTENSION USED	NOT USED
Up to 2 bends (90°elbows) with Extension kit length of 0-38 in.	STANDARD	EXTENSION	NOT USED
Up to 3 bends (90°elbows) with No Extension.	STANDARD	EXTENSION	NOT USED
IMPORTANT: Installations that exceed any of the limits above.	EXTENSION USED	NOT USED	DO NOT INSTALL
P.W.B. Jumper Wire CJ	NOT CUT	CUT	CUT

The air damper is fixed with air intake flange of the Flue pipe, as shown in Fig.2-7.
Remove the air supply elbow to remove the air damper from the air intake flange.
After the air damper has been removed, insert air supply elbow into the air intake flange and tighten by the hose band.

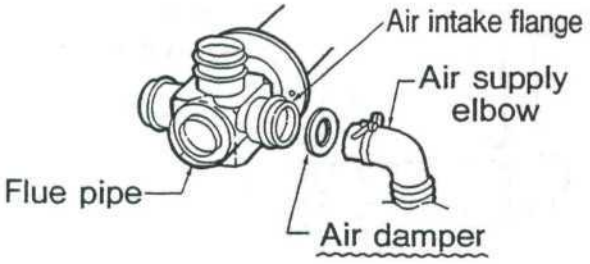
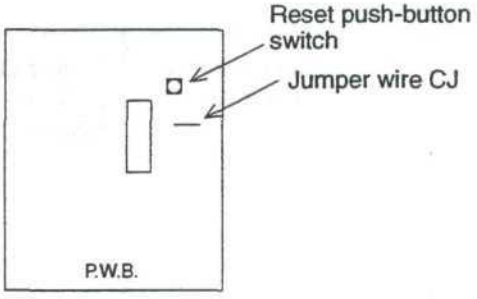


Fig. 2-7

[Position of P.W.B. jumper wire CJ and reset push-button switch]



IMPORTANT:
After cutting the jumper wire CJ, please be sure to press the reset push-button switch on the P.W.B. two to three times, with the power plug inserted in the socket.
If the reset button has been pressed, settings such as the current time, current day of the week, economy plus and child lock functions will be canceled, and these programs must be set again.

Applicable Wall Thickness of Flue Pipe.

The flue pipe attached to the heater can be installed in the wall thickness from 0.6in.(1.5cm)up to 8.5in.(22cm).

In case the flue pipe will be installed in the wall thickness more that 8.5in., the optional part, Flue Pipe Kit should be used.
For the types of flue pipe kits and their applicable wall thickness, please refer to Table 2-3.

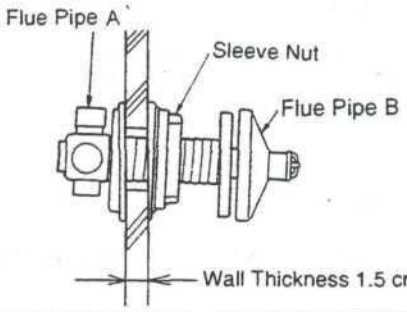
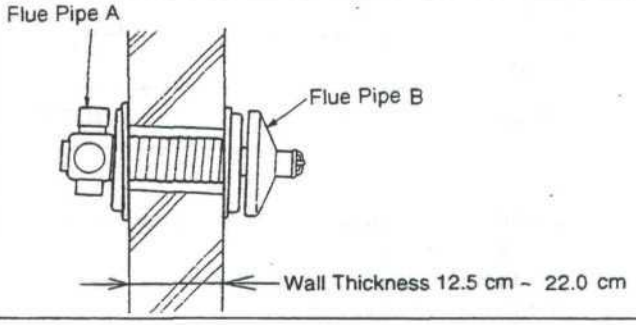
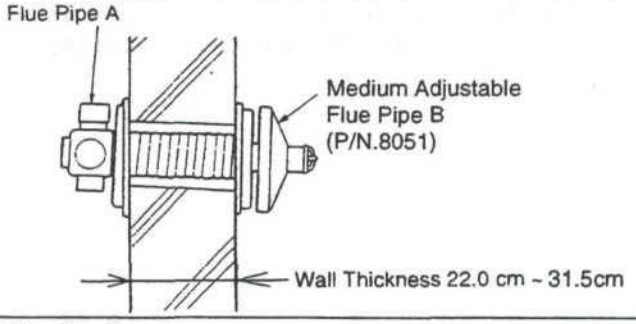
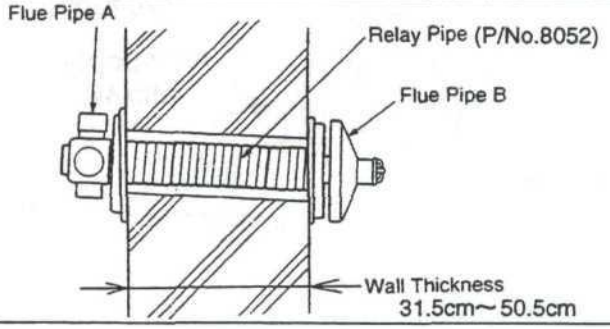
1	Standard Flue Pipe	Thickness of walls 1.5cm～12.5cm 0.6in～5in	 Since the installing dimension can not be decrease to less than 5in. (12.5cm), fix the flue pipe by using the Sleeve Nut attached to the heater.
		Thickness of walls 12.5cm～22.0cm 5in～8.5in	
2	Medium Adjustable Flue Pipe Kit	Thickness of walls 22.0cm～31.5cm 8.5in～12.5in	
3	Long Adjustable Flue Pipe Kit	Thickness of walls 31.5cm～50.5cm 12.5in～20in	

Table. 2-3

⚠CAUTION
Please be sure to observe the instruction for the types of Flue Pipe Kit and their installing wall thickness.

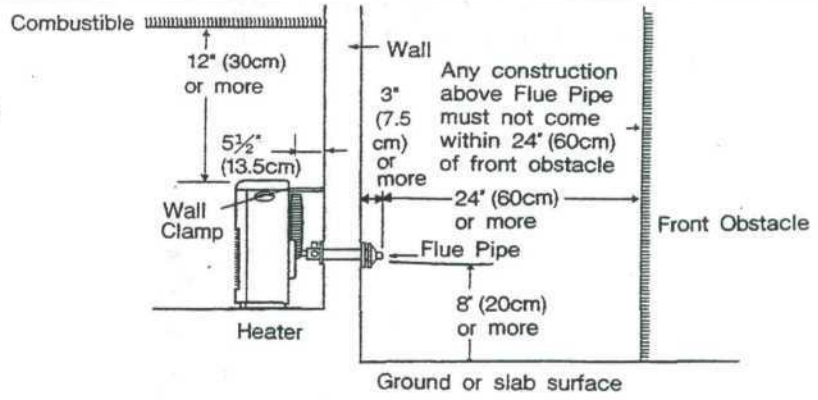
Do not install any fuel pipe kit beyond its maximum applicable wall thickness, since the connection of Flue Pipe A with Flue Pipe B, or Flue Pipe A, B, and Relay Pipe will be incomplete, it will create a hazard because of exhaust gas leakage.

FLUE PIPE CLEARANCES

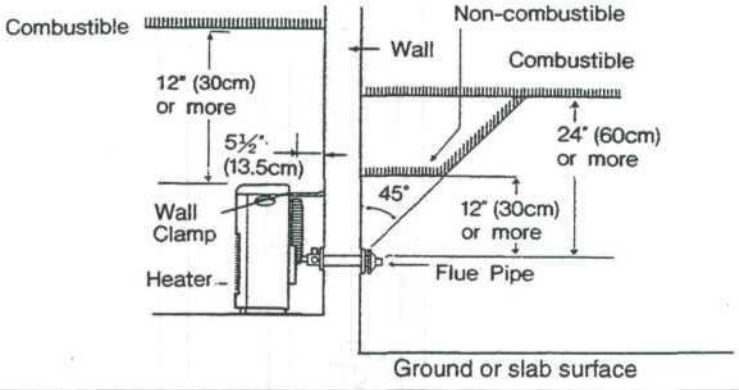
The vent terminal of a direct vent appliance with an input of 50,000 Btu per hour or less shall be located at least 9 inches from any opening through which flue gases could enter a building.
Flue pipe installations should provide for venting to an unconfined space through which there is a free flow of outdoor air. Clearances to adjacent walls or obstacles must comply with the requirements shown below.

Frontal Clearance

⚠CAUTION:
Do not attach anything onto the outlet of the flue pipe.



Overhead Clearance



Side Clearance

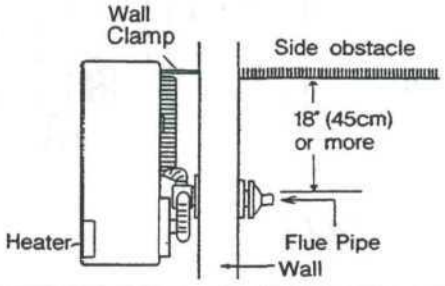
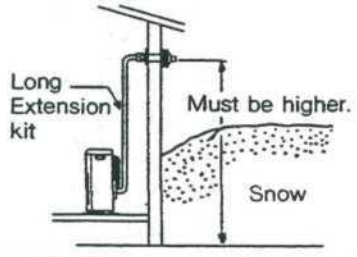


Figure 2-8

IMPORTANT:

(1) In areas of heavy snow falls, ground surface clearance must be increased according to average snow falls, to prevent flue pipe from being buried.



(2) In open area with strong wind, a wind break may be necessary.

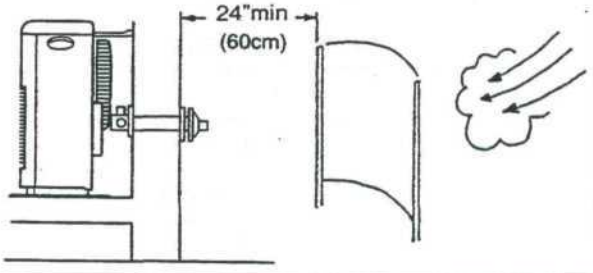
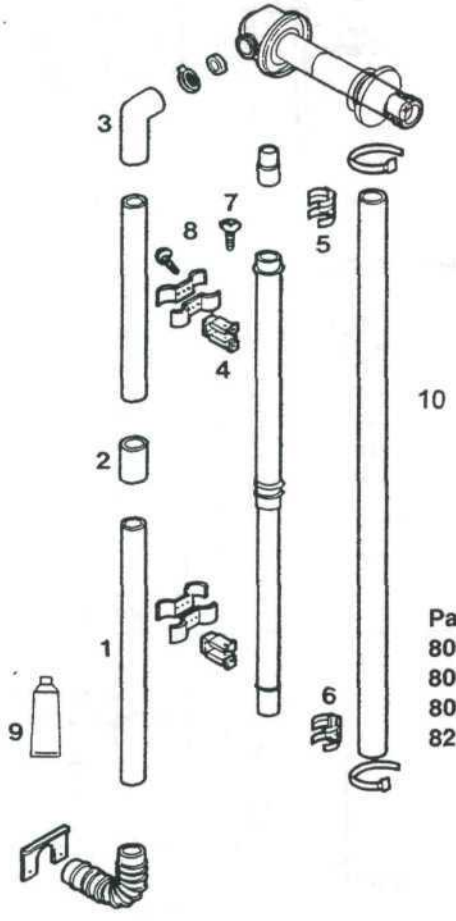


Figure 2-9

2-10 INSTALLING AN EXTENSION KIT

Installing an Extension Kit requires the construction of an air line and the exhaust line. The air line is connected between the Air Supply Elbow at the rear of the heater and the air inlet port on the Flue Pipe. Similarly, the exhaust line is connected between the joint pipe at the rear of the heater, and the exhaust port on the Flue Pipe.

IMPORTANT: The PVC air line is longer than the exhaust line and may need to be cut to size. Be sure, however, to thoroughly deburr all rough edges.



Part No.:

8002 Long Extension Kit	38 to 73 inches
8003 Medium Extension Kit	20 ¼ to 38 inches
8004 Short Extension Kit	11 ½ to 20 ¼ inches
8212 Extra Short Extension Kit	7 1/16 to 11 ½ inches

Figure 2-10 COMPONENTS OF EXTENSION KIT

ITEM#	DESCRIPTION	ITEM#	DESCRIPTION
1	PIPE, Air supply	6	PIPE CLAMP, Bottom
2	JOINT, Air line	7	SCREW, Legs, mounting
3	ELBOW 90° Air line	8	SCREW, Pipe Clamp
4	LEG, Wall-standoff	9	BOND, Adhesive
5	PIPE CLAMP, Top	10	EXHAUST INSULATING SOCK

Max lengths and bends allowable using extension kits.

Extension kits are available in four different lengths. For exact dimensions refer to the accessories catalog.

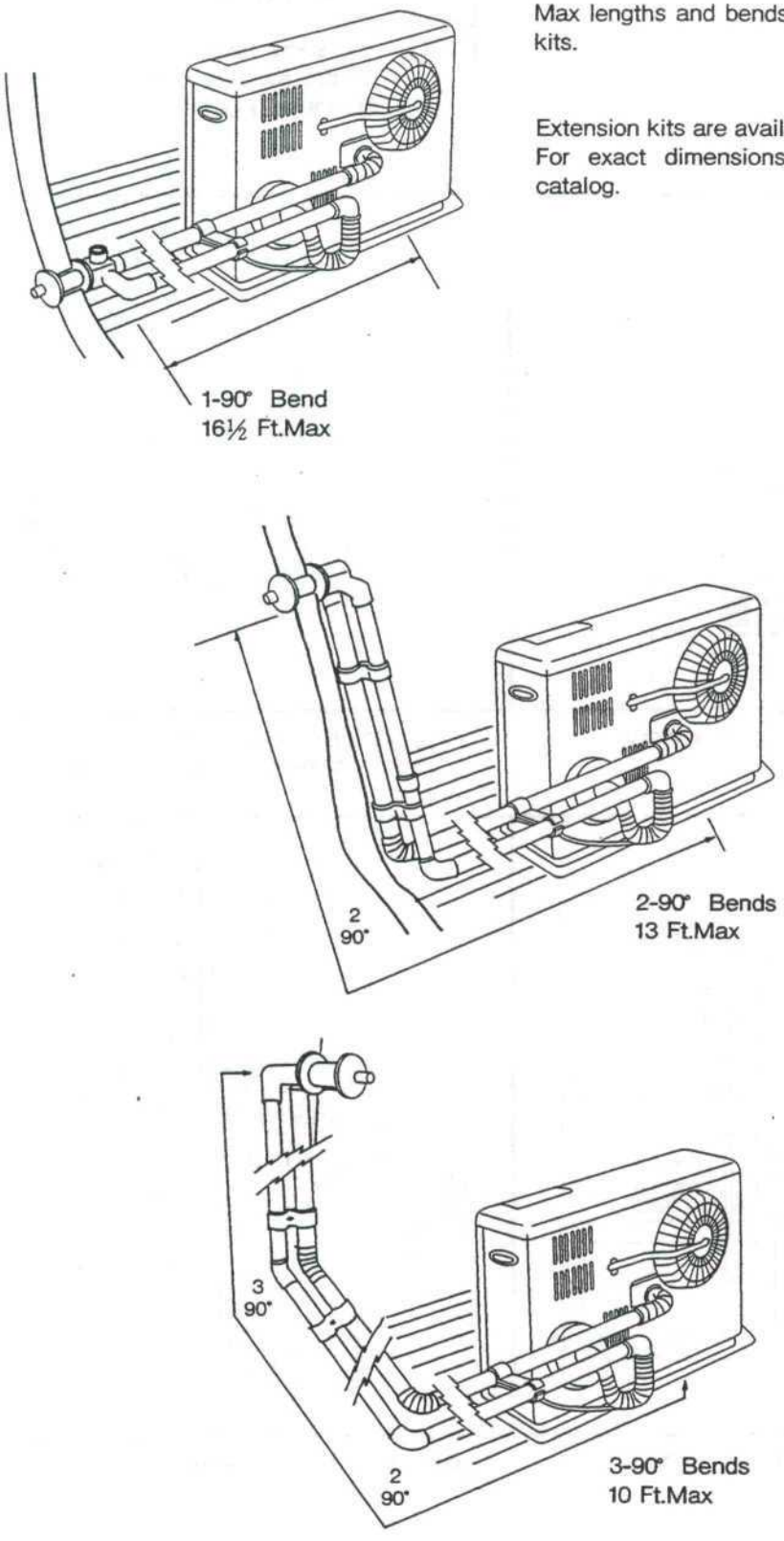
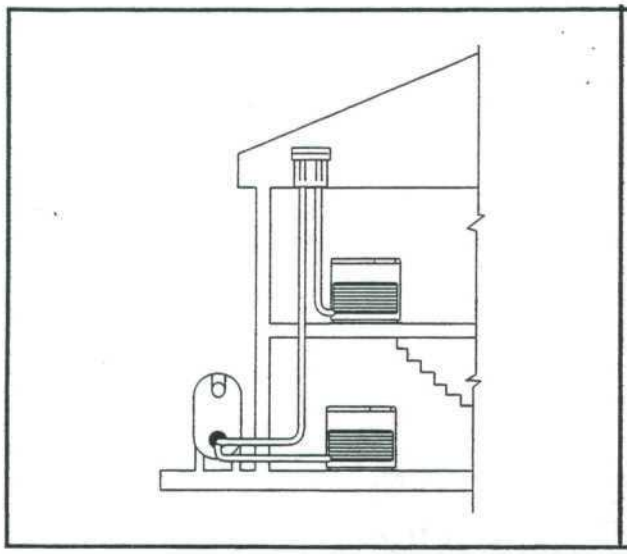


Figure 2-11 MAX LENGTHS AND BENDS ALLOWABLE USING EXTENSION KITS

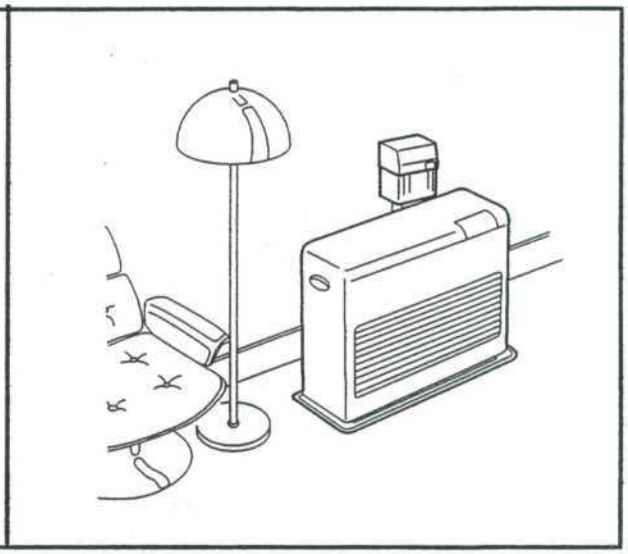
2-11 TYPICAL MONITOR LIFTER PUMP INSTALLATIONS

For more detailed information look under Kerosene Lifter manual.

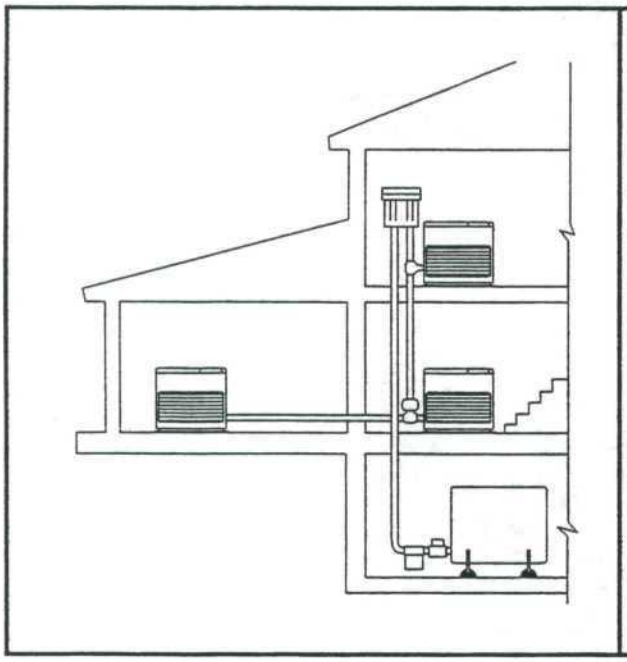
NOTE: The same minimum and maximum pump heights must be maintain as is with other fuel tanks. Figure 2-15.



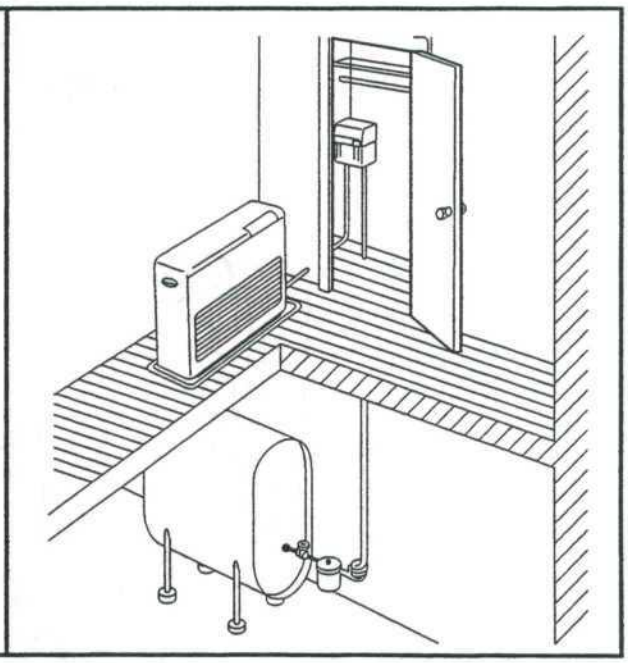
MONITOR™ KEROSENE LIFTER



MONITOR™ KEROSENE LIFTER
(CAN BE POSITIONED BEHIND UNIT)



MONITOR™ KEROSENE LIFTER



MONITOR™ KEROSENE LIFTER/GRAVITY

Figure 2-12

2-12 USES FOR THE ELBOW ADAPTER KIT

Convert from Monitor 20/30 to 2200/2400 using an elbow adapter Kit (part#8213A) and utilizing existing flue pipe installation.

PARTS LIST EXPLODED

Ref. No.	Name of Part	No in Unit
1	Exhaust Pipe Clamp	
2	Exhaust Elbow	1
3	Exhaust Joint	1
4	Joint Supporter	1
5	Heat Insulation Cover	1
6	Self-Tapping Screws	2
7	Hose Clamp (this part comes with your Monitor™ Heater)	
8	Air Damper (this part comes with your Monitor™ Heater)	
9	Flue Pipe (this part comes with your Monitor™ Heater)	

A. Remove Monitor 20/30 heater and flue pipe.
B. Install Monitor 2200/2400 flue pipe into sleeve.
C. Slide the exhaust elbow onto the exhaust port opening on the rear of the heater. (To locate exhaust port opening, see your Monitor Owner's Guide.)
D. Secure the exhaust elbow by attaching the exhaust pipe clamp to the heater cabinet with two self-tapping screws.
E. Cover the adjustable exhaust pipe with heat insulation cover.

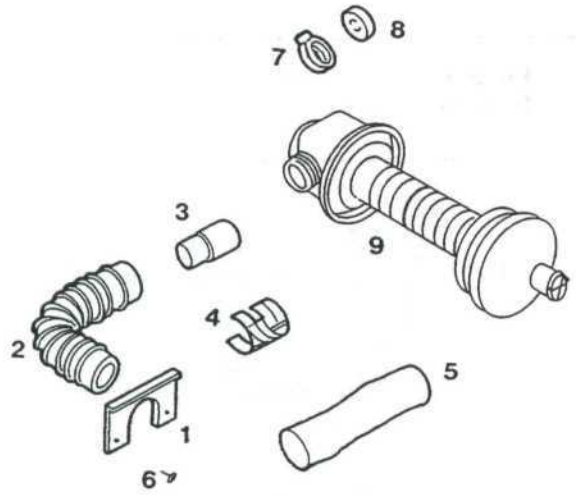


Figure 2-13

F. Remove metal cap on side mounted exhaust port of flue pipe and replace into the port.

NOTE: Be sure the exhaust elbow is firmly fixed on the flue pipe with a joint supporter.

G. Insert air supply elbow opening over flue pipe air intake flange and secure with hose clamp.

NOTE: The Standard Air Damper is installed over the flue pipe "air intake flange." (To locate flue pipe "air intake flange", see your Monitor™ Owner's Guide.)

Elbow adapter kits may also be used to raise a flue pipe high enough to clear certain base board heating systems.

2-13 FUEL TANK INSTALLATION

Pictorial views of alternative types of storage facilities and delivery systems are illustrated (Figure 2-15).

Since fuel storage tank installation techniques vary from place-to-place (often dependent upon applicable codes), a particular installation procedure cannot be specified. However, certain criteria govern the fuel hook-up of the Monitor. Use the following check list as a guide to the fuel storage facilities:

⚠ WARNING:

USE ONLY CRYSTAL CLEAR KEROSENE. NEVER USE GASOLINE, WHITE GAS, CAMP FUEL OR OTHER FLAMMABLE LIQUIDS. USE OF SUCH FUELS CAN RESULT IN AN EXPLOSIVE FIRE AND CAUSE SEVERE INJURY.

Fueling Options Available

Fueling of the Monitor Heating Systems can be accomplished in one of 2 ways:

1. Gravity Fed Large Capacity External Tank: Practical for large heating needs where bulk delivery of kerosene is available. This system should be installed by a qualified plumber or fuel supply technician.
*2. Large Capacity External Tank with Pump: For large heating needs where a gravity fed system is not practical. An electric pump, the Monitor™ Kerosene Lifter, especially designed for use with Monitor heating systems.

*if a pumping system is used to supply fuel, the inlet pressure to the heater must not exceed 2.5psi.

To install a large capacity, gravity fed external tank, follow the instructions below. Use of a qualified installer is recommended.

- Installation height of the bottom of the fuel tank should be 16 inches or more above the floor surface on which the heater stands. This insures that inlet fuel pressure will be sufficient. The top of the fuel tank should be no higher than 8½ feet above the floor under the heater. This insures that inlet fuel pressure will not be excessive.
- The horizontal length of piping should not exceed 100 feet and should be free of sharp bends or obstructions. If using lifter pump, max. length of piping is 164 ft.
- Piping should include no inverse U-type bends (to avoid air locks, which could block the fuel supply).
- Only ⅜ inch OD copper tubing should be used. The tubing should be bent carefully to avoid crimping.
- A fuel filter is recommended for use on the fuel line near tank, and a shut-off valve should be installed at the tank.
- Flare connections should be used at the fusible link valve connection on the heater and at the fuel filter to be installed at the tank.
- The fuel tank should be located no closer than 3 feet from flue pipe.
- The fuel tank should have an opening for filling on the top and a vent with a weather-proof cap on the side. On some tanks the vent and fill spout use the same opening.

55, 100, and 250 gallon tanks must contain:

- Shut-off valve at tank outlet
- Disposable fuel filter (protects heater against condensation and other impurities)
- Fueling inlet (protected by weather-proof cap)
- Ventilation outlet
- Clearance of at least 3' from any source of heat

Allowable Height Dimensions:

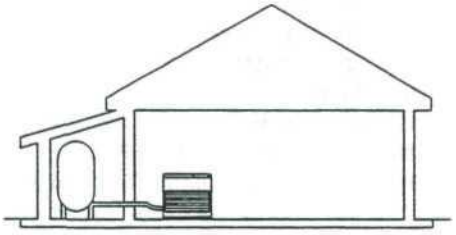
- Bottom of tank-at least 16" above floor holding heater (maintains sufficient pressure)
- Top of tank-maximum of 8½' above floor holding heater (prevents excessive line pressure above 2.5 psi).
- Position of Lifter-more than 8' above fuel inlet of heater requires pressure reduction valve.

RECOMMENDATION

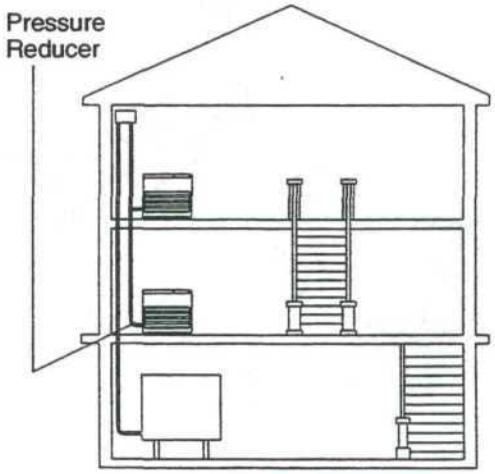
Pipe fittings in the fuel supply to the Monitor heating systems should be sealed with pipe thread tape. The supply line from the tank to the Monitor™ Kerosene Lifter must be absolutely air tight. 275 gallons and bigger tanks should have a 2.5 P.S.I. max pressure reducer to avoid excessive pressure at heater inlet.

2-14 HEATER INSTALLATION

The Monitor heaters can be physically situated on carpeting or other combustible flooring with complete safety. The selected heater site must be accessible to an electrical outlet, must support free air ciculation (both internal and external), and must not contain combustible materials in the heater's immediate vicinity.

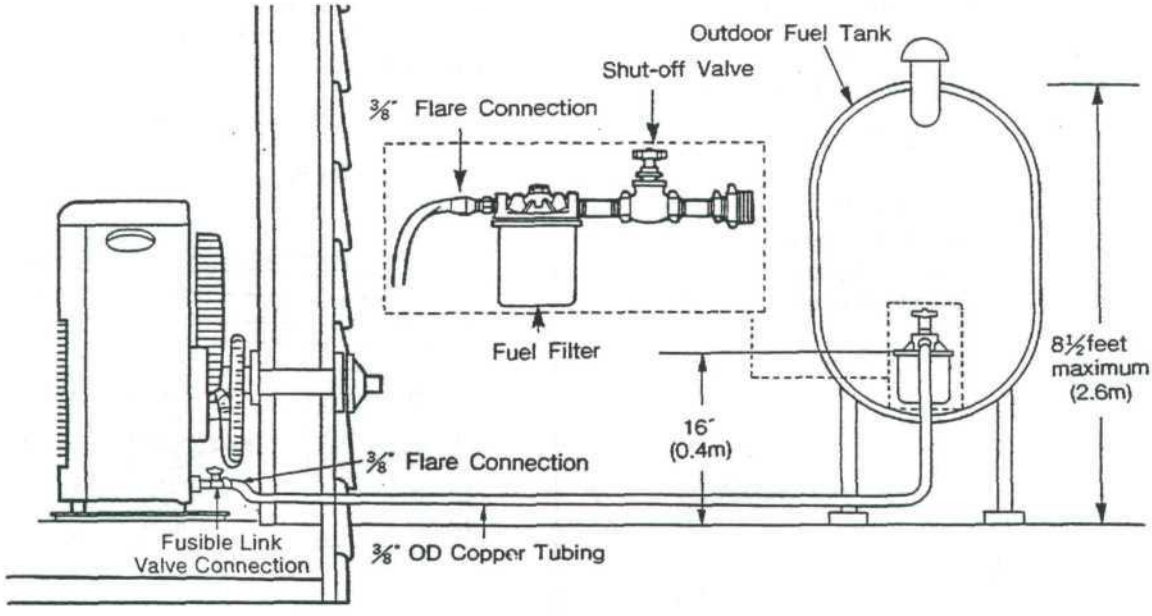


Interior or exterior gravity-fed 55, 100, or 275-gallon tank



Lifter circulates fuel from remote storage tank

Figure 2-14 ALTERNATIVE SOURCES OF FUEL STORAGE



NOTE: Fuel tank must be a minimum 3 feet away from flue pipe.
When choosing a filter or a replacement element do not use the felt type elements.
NOTE2 : A fusible link valve should be installed in the fuel line behind the heater.
Check local codes and regulations.

⚠ *CAUTION: Ensure that there is no fuel leakage from any of the fuel line fittings and connections.*

Figure 2-15 TYPICAL FUEL LINE CONNECTIONS

BACK GUARD

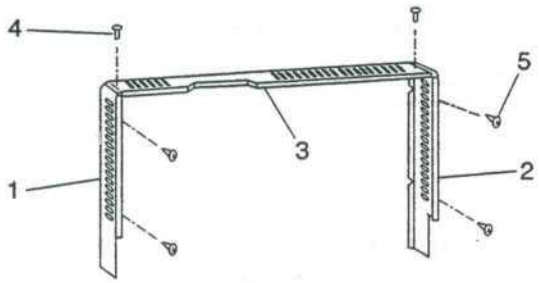
The BACK GUARD KIT is available as an accessory item. For more details, please contact your local dealer distributor or Monitor Products, Inc.

How to install the back guard

M2400 BACK GUARD KIT : Parts No.8306

PARTS LIST EXPLODED

REF. No.	PARTS NAME	Q'TY
1	Side Back Guard L	1
2	Side Back Guard R	1
3	Top Back Guard	1
4	Screws	2
5	Tapping Screw	4



Tools required : Phillips head screwdriver

1. Install the Side Back Guard

Locate the holes along the back edge of the cabinet, and start the tapping screws into those holes.

These screws will support the sides of the back guard, but do not tighten completely.

Insert the screw tabs under the tapping screw heads, and tighten each tapping screw.

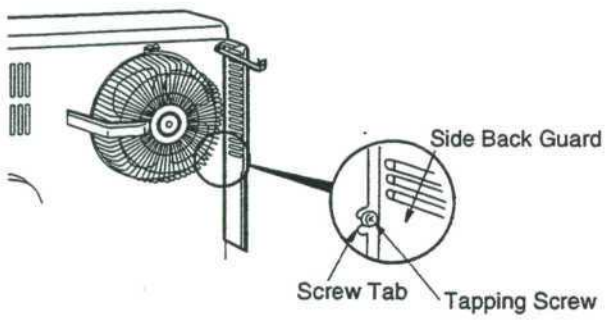


Fig. 2-16

2. Install Top Back Guard

Place Top Back Guard so that the dent is to the left as viewed from the back of heater.

Attach by placing and tightening the screws in the holes provided.

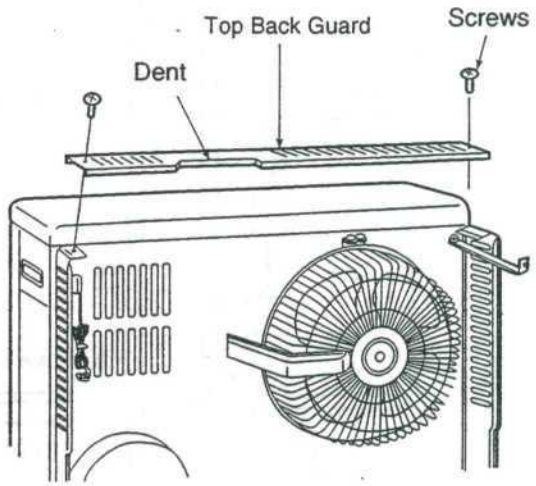


Fig. 2-17

Caution during installation

(1) Fuel inlet valve at the back of the heaters :
If a fuel valve is connected at the fuel inlet at the back of the heater, adjust the position of the fuel valve so that its control knob does not touch the back guard.

(2) In the case of a standard installation (Flue pipe directly behind the heater) :
1. In order to install the back guard on a heater already in operation, move the heater away from the wall so that you can easily use a screw driver to install the side pieces.
2. Install the top piece after the side pieces have been attached, and the heater has been reinstalled with the wall clamps attached to the wall.

(3) If using extension kits :
Install the back guards in accordance with Figure 2-18, page 25.

Caution in using the back guards

(1) Remove the top back guard when cleaning the circulation fan assembly and rear of heater.

(2) To prevent overheating the Monitor, ensure that the slits in the back guard are not blocked by curtains or other obstructions.

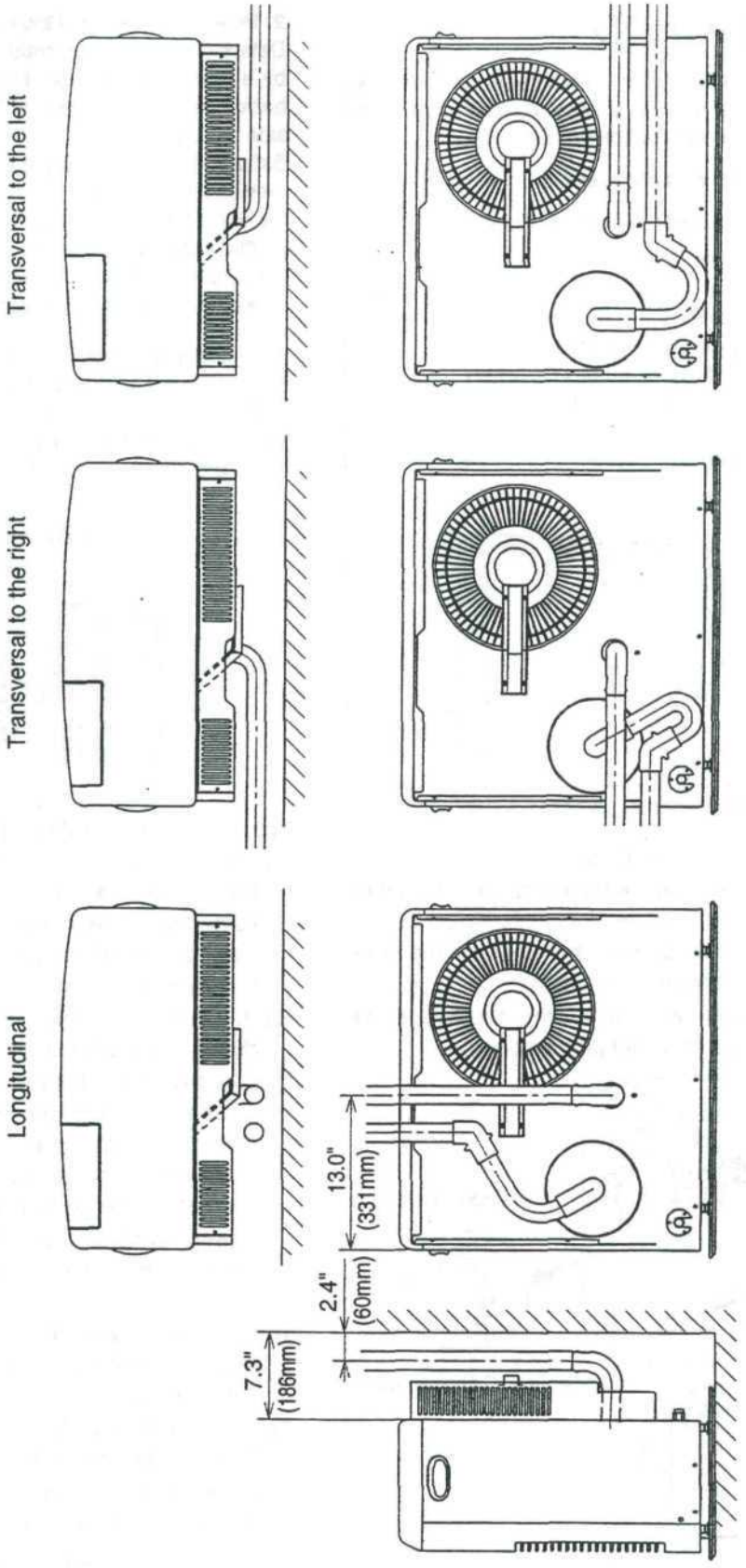


Fig. 2-18 M-2400 Extension Kit Installations with Back Guards Attached

BACK GUARD

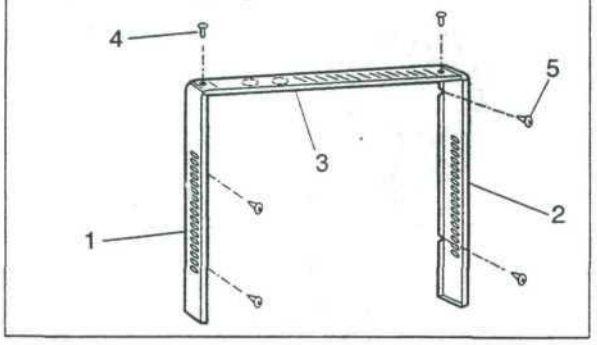
The BACK GUARD KIT is available as an accessory item. For more details, please contact your local dealer distributor or Monitor Products, Inc.

How to install the back guard

M2200 BACK GUARD KIT : Parts No.8307

PARTS LIST EXPLODED

REF. No.	PARTS NAME	Q'TY
1	Side Back Guard L	1
2	Side Back Guard R	1
3	Top Back Guard	1
4	Screws	2
5	Tapping Screw	4



Tools required : Phillips head screwdriver

1. Install the Side Back Guard

Locate the holes along the back edge of the cabinet, and start the tapping screws into those holes.

These screws will support the sides of the back guard, but do not tighten completely.

Insert the screw tabs under the tapping screw heads, and tighten each tapping screw.

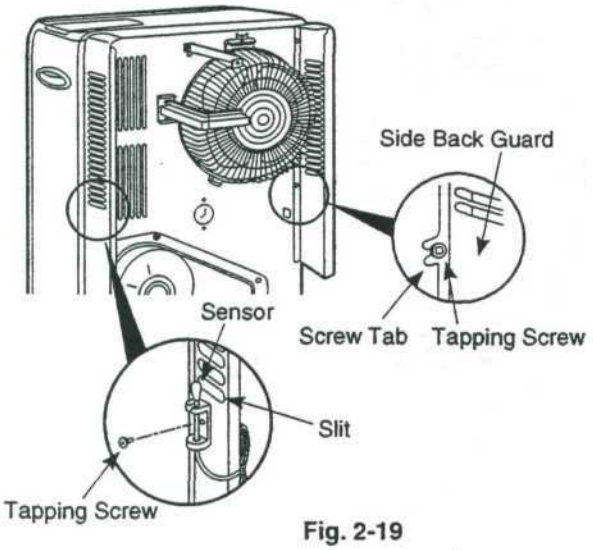


Fig. 2-19

2. Move the location of the Room Temperature Sensor

Detach the Room Temperature Sensor, which is secured by a tapping screw, from the upper part of the heaters back. Relocate the sensor to below the bottom slit of the side back guard.

Secure it by tightening the tapping screw into hole provided. (Fig. 2-19)

the Room Temp Sensor should be moved as described above so that it will read the room temperature more accurately.

CAUTION : Make sure that the lead wire of the Temp. Sensor does not come in contact with the Joint or Flue Pipe.

3. Install Top Back Guard

Place Top Back Guard so that the knockout holes are to the left as viewed from the back of heater.

Attach by placing and tightening the screws in the holes provided. (Fig. 2-20)

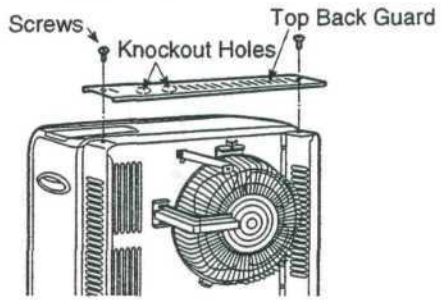


Fig. 2-20

Caution during installation

(1) Fuel inlet valve at the back of the heaters :
If a fuel valve is connected at the fuel inlet at the back of the heater, adjust the position of the fuel valve so that its control knob does not touch the back guard.

(2) In the case of a standard installation (Flue pipe directly behind the heater) :
1. In order to install the back guard on a heater already in operation, move the heater away from the wall so that you can easily use a screw driver to install the side pieces.
2. Install the top piece after the side pieces have been attached, and the heater has been reinstalled with the body clamp attached to the wall.

(3) If using extension kits :
Install the back guards in accordance with Figure 2-21, page 27.

Caution in using the back guards

(1) Remove the top back guard when cleaning the circulation fan assembly and rear of heater.

(2) To prevent overheating the Monitor, ensure that the slits in the back guard are not blocked by curtains or other obstructions.

Extension installation without the extension pipes through the back guard knockout holes.

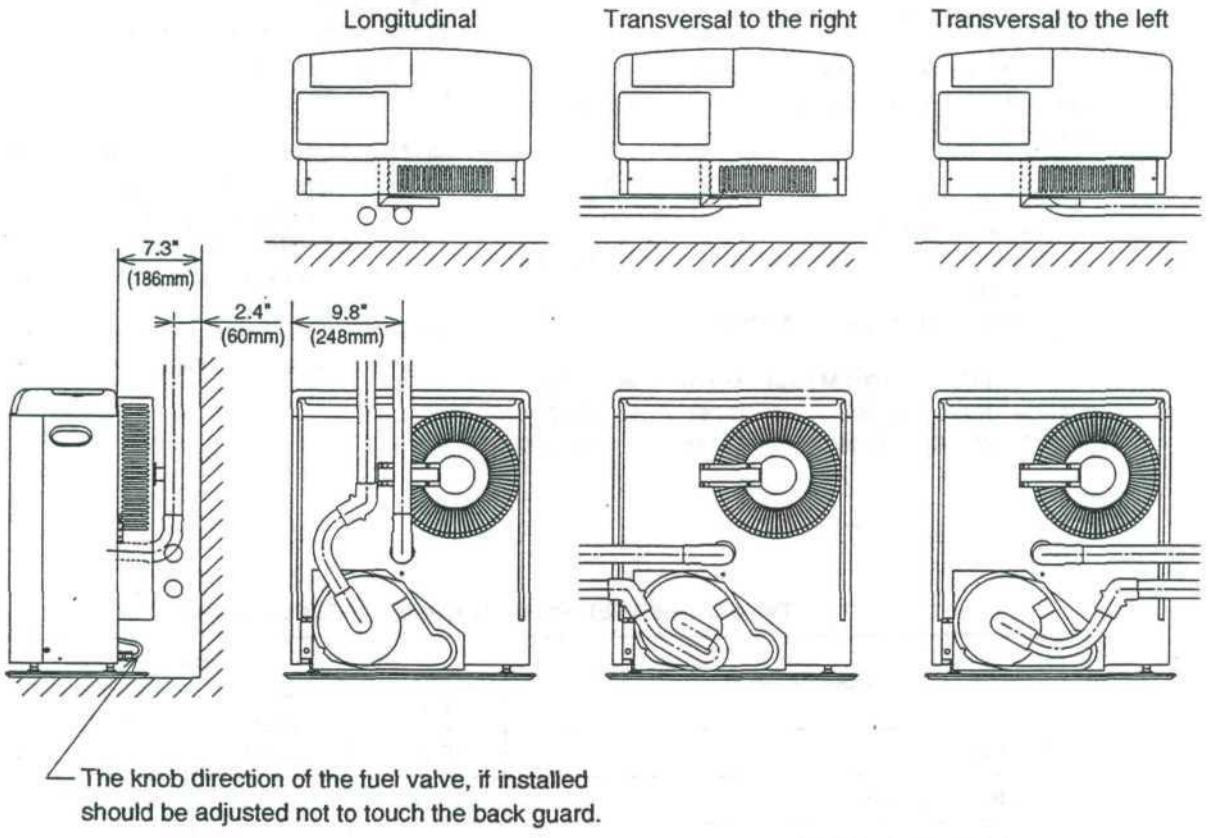


Fig. 2-21 M-2200 Extension Kit Installations with Back Guards Attached

3-1 INTRODUCTION

Monitor is an easy-to-operate vented kerosene heater. Routine operation features high BTU output. automatic adjustment of room temperature, low fuel and power consumption, and choice of automatic or manual heater operation.

This section provides all information necessary to operate the Monitor Heating System. All operation procedures specified should be performed in the order in which they are described.

3-2 OPERATING SPECIFICATIONS

The following specifications apply to the operation of the Monitor 2400.

- — Rated Efficiency (as applied to kerosene heaters): 93%*
- — Rated Efficiency (as applied to central heating systems): 88%
- — Power Consumption : as follows

	HIGH	MEDIUM-HIGH	MEDIUM-LOW	LOW
IGNITION	BURN	BURN	BURN	BURN
310watts	68watts	61watts	52watts	45watts

- — Circulation Fan Output : 388 cubic feet/min.
- — Fuel source : Remote, separate tank
- — Potential heating area : 900-3200 sq. feet

*The energy from the combustion process is released in the form of heat and vaporized water. Normally, heating systems discharge water from combustion to the atmosphere without condensing it. This 93% efficiency rating means that, assuming the water cannot be condensed, 93% of the heat produced by the combustion process is recovered. Assuming the water can be condensed, the efficiency is 88%.

NOTE: Actual effective heating area depends upon numerous factors such as type and severity of climate, type of dwelling construction, condition of dwelling, and thickness and effectiveness of dwelling insulation.

Table 3-1 lists Monitor 2400 performance specifications at various user-selected heat output settings.

Table 3-1 HEATER PERFORMANCE SPECIFICATIONS

Specification	Setting			
	Low	Medium Low	Medium High	High
Rating	16,200	24,600	32,000	43,000
Heater Output/hr.	13,600	20,700	26,900	37,200
Fuel Consumption (gal/hr)	0.12	0.18	0.24	0.319
8-hrs/day burntime (5-gal. tank)	5.2days	3.5days	2.6days	2.0days
Continuous-use burntime (5-gal.tank)	41.7hrs.	27.8hrs.	20.8hrs.	15.7hrs.
8-hrs/day burntime (55-gal.tank)	57.3days	38.2days	28.6days	21.6days
Continuous-use burntime (55-gal.tank)	19.1days	12.7days	9.5days	7.2days
8-hrs/day burntime (275-gal.tank)	286.5days	191days	143.2days	107.8days
Continuous-use burntime (275-gal.tank)	95.5days	63.7days	47.7days	35.9days

3-3 INTRODUCTION

Monitor is an easy-to-operate vented kerosene heater. Routine operation features high BTU output automatic adjustment of room temperature, low fuel and power consumption, and choice of automatic or manual heater operation.

This section provides all information necessary to operate the Monitor Heating System. All operation procedures specified should be performed in the order in which they are described.

3-4 OPERATING SPECIFICATIONS

The following specifications apply to the operation of the Monitor 2200.

- — Rated Efficiency (as applied to kerosene heaters): 93%*
- — Rated Efficiency (as applied to central heating systems): 88%
- — Power Consumption : as follows

	HIGH	MEDIUM-HIGH	MEDIUM-LOW	LOW
IGNITION	BURN	BURN	BURN	BURN
250watts	41watts	38watts	32watts	31watts

- — Circulation Fan Output : 176 cubic feet /min.
- — Fuel source : Remote, separate tank(1.32 U.S. gal., capsule tank optional)
- — Potential heating area : 600-1200 sq. feet

*The energy from the combustion process is released in the form of heat and vaporized water. Normally, heating systems discharge water from combustion to the atmosphere without condensing it. This 93% efficiency rating means that, assuming the water cannot be condensed, 93% of the heat produced by the combustion process is recovered. Assuming the water can be condensed, the efficiency is 88%

NOTE: Actual effective heating area depends upon numerous factors such as type and severity of climate, type of dwelling construction, condition of dwelling, and thickness and effectiveness of dwelling insulation.

Table 3-2 lists Monitor 2200 performance specifications at various user-selected heat output settings.

Table 3-2 HEATER PERFORMANCE SPECIFICATIONS

Specification	Setting			
	Low	Medium Low	Medium High	High
Rating	9,600	12,400	17,400	22,000
Heater Output/hr.	7,970	10,290	14,440	18,260
Fuel Consumption(gal/hr)	0.07	0.09	0.13	0.164
8-hrs/day burntime(1.32-gal. tank)	2.4days	1.8days	1.3days	1.0days
Continuous-use burntime (1.32-gal.tank)	18.9hrs.	14.7hrs.	10.2hrs.	8.0hrs.
8-hrs/ day burntime (55-gal.tank)	98.2days	76.4days	52.9days	41.9days
Continuous-use burntime (55-gal.tank)	32.7days	25.5days	17.6days	14.0days
8-hrs/ day burntime (275-gal.tank)	491days	382days	264days	210days
Continuous-use burntime (275-gal.tank)	164days	127days	88days	70days

NOTE: Capsule tank cannot be used in Connecticut.

3-5 OPERATING CONTROLS AND INDICATORS

Several controls and indicators are used to operate the heater and to monitor its performance as follows:

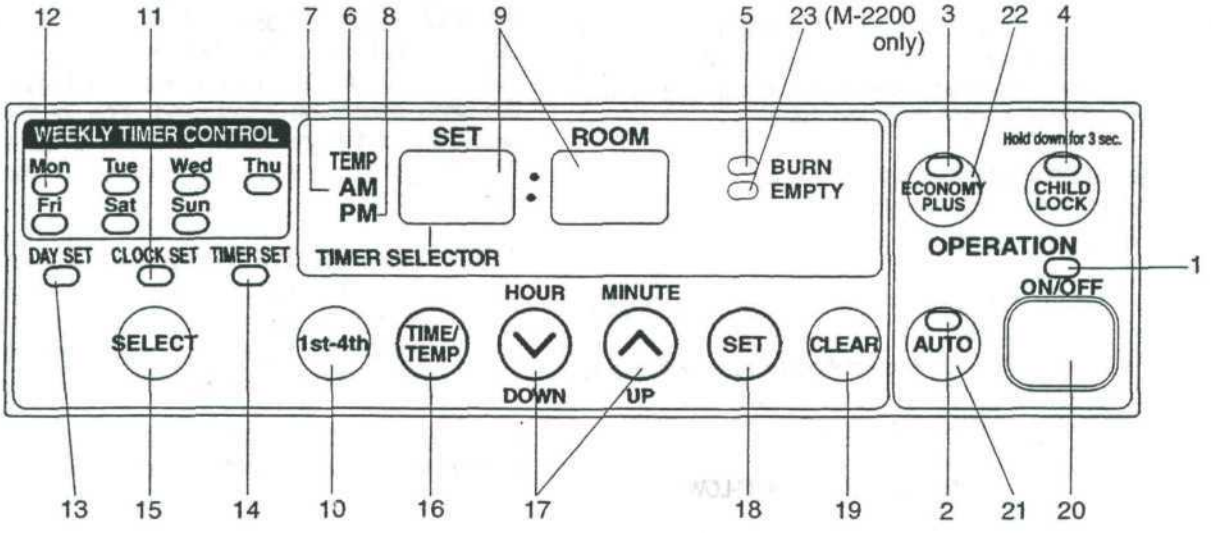


Fig. 3-1

ITEM NO	CONTROL OR INDICATOR.	FUNCTION
Item1	OPERATION Indicator Light	Light to indicate that power has been applied to heater. Illuminates when operation ON/OFF pushbutton switch is pressed to position ON
Item2	AUTO Indicator Light	Lights when heater runs in automatic mode. AUTO, OPERATION, and appropriate BURN Indicators are illuminated simultaneously if heater is burning.
Item3	ECONOMY PLUS Indicator Light	Lights when heater runs in Economy Plus mode.
Item4	CHILD LOCK Indicator Light and push-button switch	Lights when heater runs in CHILD LOCK mode.
Item5	BURN Status Indicator Light	Lights when heater is burning. (This light will turn on when the Solenoid Pump is working.)

ITEM NO	CONTROL OR INDICATOR.	FUNCTION
Item6	TEMP Indicator Light	Lights when heater is running and Digital Window is showing the temperature.
Item7	AM Indicator Light	
Item8	PM Indicator Light	
Item9	Digital Display	Indicates SET and ROOM temperature when heater is running, and indicates time when heater is Off. Indicates time and temperature for automatic operation setting.
Item10	1th-4th push-button switch	The automatic function allows the programming of different temperatures for different times of the day. Two, three or four settings can be used. IMPORTANT: Once time and temperature have been programmed, the SET push-button switch must be pressed with in 60 seconds. Otherwise, time and temperature will revert to previously programmed time, if any.
Item11	CLOCK SET Indicator Light	Allows programming of current time when illuminated. NOTE: Prior to programming current time, Digital Display shows 88:88. IMPORTANT: Once current time has been programmed, press the SET pushbutton switch within 60 seconds. Otherwise clock display will revert to previously programmed time, if any.
Item12	WEEKLY Indicator Lights	One of the lamp for the week, will turn on, when setting the program for the selecting day of the week.
Item13	DAY SET Indicator Light	When the program for the current day of the week has been selected, the indicator light will turn on.
Item14	TIMER SET Indicator Light	When the timer program has been set, the indicator light will turn on.

ITEM NO	CONTROL OR INDICATOR.	FUNCTION
Item15	SELECT push-button switch	This switch will be used for the selection of the DAY SET, CLOCK SET, TIMER SET and also for the day of the week (Mon, Tue, Wed, Thu, Fri, Sat, Sun).
Item16	TIME push-button switch	This switch is used to set time and change display over.
	TEMP push-button switch	This switch is used to set temperature and change display over, in 2 degree increments.
Item17	HOUR/DOWN MINUTE/UP repetitive-action push-button switch	Programs time or temperature. NOTE: Each time push-button switch is pressed, the digit advances in increments of one digit, If push-button is pressed and held, the digits are advanced repetitively.
Item18	SET push-button switch	"Sets" time and/or temperature. If this control is not pressed after time and/or temperature have been programmed, the time and/or temperature programmed (as indicated by display window) will not be accepted, and will revert to previously programmed time and/or temperature.
Item19	CLEAR push-button switch	Erases any programmed time and temperature. When cleared, time and/or temperature previously programmed and displayed disappear(s) from window. IMPORTANT: Both current time and current day of the week will have to be reprogrammed if electrical operation is interrupted by power failure or by disconnecting heater plug from wall outlet beyond 30 minutes. If this occurs, the heater will go into MANUAL mode of operation.
Item20	ON/OFF push-button switch	ON position (push-button is "in") applies power to the unit. When this occurs. the OPERATION indicator light to Indicate that heater operation has begun. OFF position (push-button is "out") remove power from the heater. All circuits-except for Clock and Air Flow — are shut down.

ITEM NO	CONTROL OR INDICATOR.	FUNCTION
Item 21	AUTO push-button switch	Places heater in automatic mode of operation. AUTO indicator lights to confirm automatic operation. Assuming that the heater has been properly programmed and heater is in ON position, heater will operate automatically. When pressed again, AUTO indicator goes out and then heater will operate in MANUAL mode. During manual operation, the user turns heater ON and OFF, at will. When AUTO is disengaged, the unit will operate on a manual temperature determined by the AUTO setting for that time of day.
Item 22	ECONOMY PLUS push-button switch	Places heater in Economy Plus mode of operation. ECONOMY PLUS indicator lights to confirm Economy Plus operation. When pressed again, ECONOMY PLUS indicator goes out and then Economy Plus mode will be cancelled. **NOTE:** Economy Plus mode is accepted only in the MANUAL mode.
Item 23	EMPTY Indicator Light	In case of using the capsule tank, when the fuel is empty, EMPTY Indicator Light blinks.

3-6 PRE-OPERATION CHECK LIST

After heater installation, but prior to Monitor heater start-up, inspect the system for operational readiness. The following check list specifies those items that should be inspected on a routine basis:

- ✓ Check that the Monitor heater is plugged into wall outlet (120 Vac, 60 Hz)
- ✓ Verify that adequate supply of kerosene is available in fuel tank
- ✓ Confirm that fuel is free of water or other contaminants
- ✓ Check fuel tank for good operating condition; it must be free of rust, corrosion, and/or leaks
- ✓ Inspect Fuel Line for signs of leaks, loose connections, cracks, air pockets or blockages
- ✓ Confirm that Fuel Valves on Fuel Tank and Shut-off Valve are open so fuel can flow freely
- ✓ Outside dwelling, check area immediately around Flue Pipe for combustibles or obstructions to free air circulation
- ✓ Inspect Air Line for cracks, loose connections or blockage
- ✓ Check Exhaust Line for cracks, loose connections or blockage
- ✓ At rear of heater, verify that air flow to the Air Circulation Fan is not blocked
- ✓ Inspect dwelling interior and confirm that immediate area near heater is free of combustible and objects that might interfere with free air flow.
- ✓ Make certain that Heat Sensor is not exposed to drafts, direct sunlight, nor direct heat from the Monitor.
- ✓ Confirm that heater is level

If this inspection reveals any system deficiencies, correct the problems before operating the heater.

3-7 OPERATION

Operation of Monitor heater can be controlled manually by the user, or run automatically by the microprocessor.

Paragraphs 3-8 through 3-12 provide the details of heater start-up, operation, and shutdown. The controls and indicatoes illustrated by Fig. 3-1 used to operate the system and to monitor the heater's performance.

3-8 MANUAL HEATER OPERATION

Operation of the heater is under the direct control of the user (heater will not operate automatically). The heater will, however, automatically respond to changes in room temperature signaled by the Heat Sensor to maintain the temperature of the room at a comfortable level.

NOTE: Resetting the Fuel Constant Level Valve is necessary only if the heater is being started for the first time, hasn't been used for an extended period of time, or if tank has run empty. If priming is unnecessary skip to step 2.

STEP1: Prime the Heater
Gently press and release the Fuel Constant Level Valve Reset button two or three times.

STEP2: Select Manual Opereation
If heater operation is in AUTO mode, press the AUTO push-button switch and change Auto to Manual mode.

STEP3: Select Temperature Setting
After pressing the TIME/TEMP push-button switch to indicate the Set Temperature and Room Temperature in the display window, press either the UP or DOWN push -button switch to set the digital set room temperature indicator to the desired temperature, and then press the SET push-button switch.

IMPORTANT: In case no temperature is set, temperature will automatically be set at the initial set temperature.

STEP4: Turn Monitor On
Press the ON/OFF push button switch to position ON. The operation indicator light illuminates to indicate that power has been applied to the instrument and the heater is cycled for manual mode of operation.

INSTRUCTIONS FOR ECONOMY PLUS MODE
To engage the economy plus mode, simply press down the button labeled "Economy Plus", to disengage press again.

NOTE: Operation switch must be "ON" and in MANUAL mode.

This feature minimizes the "ON" and "OFF" cycling of the unit by allowing it to overshoot the set temperature by 8 degrees instead of the normal 4 degrees.
The advantages of this feature are to increase the overall efficiency of the unit by:

1. Decreasing electrical consumption by decreasing the frequency of ignition cycles.
2. Reducing heat loss during the prepurge and postpurge cycles.
3. Reducing inefficient combustion associated with start up and shut down.
4. Prolonging component life by decreasing expansion and contraction of internal parts.

NOTE: This feature could be compared to driving an automobile in stop and go traffic (regular mode) versus highway driving with cruise control engaged (Economy Plus mode).

3-9 AUTOMATIC HEATER OPERATION

Automatic operation is established by programming the time/temperature settings for specific times for each day. On a daily basis, a maximum of four time/temperature settings can be programmed.

If, subsequently, it should be desired to switch to manual mode of operation, the changeover can be made at any time.

Proceed with automatic mode of operation in the following manner:

Step1: Set the Day of Week
Press the "SELECT" Button, at which time the "DAY SET" Light will illuminate. The "Mon" Light will illuminated and flash at this point.
Illuminate and flash the light of the current day of the week (e.g.; "Wed") by pressing the "UP" or "DOWN" Button, and then press the "SET" Button to lock into memory. The current day (e.g.; "Wed") light will illuminate continuously.

Step2: Set the Time
Press the "SELECT" Button, at which time the "CLOCK SET" Light will illuminate. The LED indicator in the Display Window will show 88:88 at this point.

Step3: Set the Hour
Press the "HOUR" Button until the correct hour (either A.M. or P.M.) appears in the window.
NOTE: The "HOUR" and "MINUTE" Buttons can be pressed and held or pressed momentarily to change the time.

Step4: Set the Minute
Press the "MINUTE" Button until the correct time appears in the window.
Immediately press the "SET" Button.
NOTE: If the "SET" Button is not pressed within 1minute after the time set, the programming will be cancelled.

3-10 PROGRAMMING THE WEEKLY TIMER FOR AUTOMATIC HEATER OPERATION

The Monitor 2400/2200 Heating System is capable of providing up to 4 different temperature setting for 4 different times of each day of the week. Not all 4 settings have to be used; 2, 3 or 4 settings can be used. A clear understanding of programming temperatures, time and day of the week from the previous pages is needed before programming the automatic settings. Also, the present time and the day of the week must have been set.

This system is capable of programming Monday to Friday, Saturday and Sunday to same 4 programs as shown in the table or each day can have a different set of 4 programs. Also, this system is capable of programming all 7 days to have the same set.

Suggested weekday and weekend programs are shown below;

Suggested Programs

Mon - Fri

	Time	Temperature
1st	6:00 AM	68°F
2nd	8:30 AM	60°F
3rd	5:00 PM	68°F
4th	11:00 PM	58°F

Sat - Sun

	Time	Temperature
1st	7:00 AM	68°F
2nd	10:00 AM	60°F
3rd	4:00 PM	68°F
4th	11:00 PM	58°F

Step1: Seting the 1st program of Monday

Pressing the "SELECT" Button will illuminate the "TIMER SET" Light. The "Mon" Light will illuminate and flash, and the "TIMER SELECTOR" LED indicator in the Display Window will show "*1*" at this point.

Pressing the "TIME/TEMP" Button will illuminate the ":" Light in the Display Window, and then set the 1st desired time by pressing the "HOUR" and "MINUTE" Buttons. Once the desired time "AM or PM" is displayed, press the "SET" Button to lock into memory.

Press the "TIME/TEMP" Button again. Set the desired temperature for the 1st time setting by using the "UP" and "DOWN" Buttons. Once the desired temp is displayed, press the "SET" Button to lock into memory.

Step2: Setting the 2nd, 3rd and 4th programs of Monday

Pressing the "1st-4th" Button will show "2" at the "TIMER SELECTOR" LED indicator
in the Display Window.

Follow same steps as above, except for 2nd time/temp. (ie; 2nd 8:30 AM 60°F)

Repeat 3rd and 4th settings by same steps.

Step3: Setting the programs of Tuesday - Sunday

Pressing the "SELECT" Button will illminate and flash the "Tue" Light, and the "TIMER SELECTOR" LED indicator in the Display Window will show "1" at this point.

Follow same steps as above, set the programs of Tuesday. Set the programs of remaining days in the same manner.

Step4: Setting the program by using Copy function Tuesday - Friday

You can easily duplcate Monday's program for the remainder of the week, or any group of days, by using the Copy function.

After having set the program for Monday, press the "1st-4th" Button until "*COPY*" flashes in the LED display window. Note that "Mon" is also flashing in the Weekly Timer Control panel. To copy Monday's program to Tuesday, press the "*UP*" or "*DOWN*" button to flash the "Tue" light. Both "Mon" and "Tue" lights are flashing.

Press the "SET" button, and "Tue" is steady, and "*COPY*" and "Mon" lights are flashing.

Next. Press the "*UP*" or "*DOWN*" button to illuminate "Wed" and then press "SET". "Tue" and "Wed" are both steady, but "Mon" and "*COPY*" are flashing.

Repeat the above sequence for "Thu" and "Fri".

Then hold down the "SET" button for 3 seconds, or until you hear the "BEEP" and observe that "*COPY*" stops flashing. The programs for Tue, Wed, Thu, and Fri are now copied and set.

In about 10 seconds, only "Mon" will be flashing.

Press the SELECT button to select the current day, and the TIME will appear in the display window.

Saturday - Sunday

Follow same steps as above to set the "Saturday" program. (Steps 1 and 2)

Press "1st-4th" button until "*COPY*" flashes in the display window.

Press the "UP" or "DOWN" button to illuminate "Sun" which will flash.

Press "SET" button and "Sun" will light steady.

Then, press "SET" button for 3 seconds, or until you hear the "BEEP" sound and "*COPY*" light stops flashing.

The Sunday program has been copied from Saturday.

Step5: Activate Automatic Operation

For the heater to operate on automatic once the settings are in memory, simply press the "AUTO" Button on the control panel. The "AUTO" Light will illuminate to confirm the heater is in the automatic operation mode. The heater will now maintain the programmed temp for that time of day of the week.

IMPORTANT: The heater will not operate in automatic unless the ON/OFF switch is in the "ON" position.

Step6: Clearing An Automatic Setting

If you wish to clear any automatic setting, press the "SELECT" and "1st-4th" Button to the appropriate setting and press the "CLEAR" Button. A new setting will need to be entered otherwise the old setting will return after 1 minute.

3-11 HEAT SENSOR

Heat Sensor is located on the rear of the cabinet. It is recommended to leave the sensor in its original mounted position. However should relocation be necessary, choose a location for the sensor that is not in the path of direct sunlight, drafts or the flow of warm air from the heater. Loosen the screw and release the sensor from the rear of the cabinet. Fasten the sensor to the wall with the screw.

3-12 MONITOR SHUTDOWN

A simple one-step procedure is utillized to shutdown the Monitor:
Press ON/OFF push-button switch to position OFF; the OPERATION indicator will extinguish.

IMPORTANT: Once heater has shut down, it cannot be restarted until post-purge cycle has been completed. If ON/OFF switch is left in position ON, Monitor operation will automatically restart upon completion of post-purge.

3-13 OUT OF FUEL

During either manual or automatic operation of heater, fuel in the tank may be depleted.
The Monitor is known to be out of fuel when all of the following symptoms are present:

— The code,[E14] is indicated in the display window.
— Absence of flame (visually verified through view plate on wall of Combustion Chamber).

STEP1: Turn Heater OFF
Press ON/OFF switch to OFF.

STEP2: Fill Fuel Tank
A. Close shut-off valve at outlet of Fuel Tank.
B. Drain Fuel Tank (from bottom, if possible) to remove all condensation, debris, and old fuel.
C. Fill Tank with fresh, crystal clear kerosene.
D. Upon completion of stepC, open shut-off valve which was closed in stepA above.

STEP3: Turn Heater ON
Press ON/OFF switch to ON. Proceed with normal heater operation.

3-14 RECOVERY FROM A POWER FAILURE

If power to the heater is interrupted, a thud-like noise may be heard in the combustion chamber. This is normal, and should not cause alarm.
For power interruptions of up to 30 minutes, the set memory is kept and will resume operation automatically with the set memory.
For power interruptions beyond 30 minutes, your heater will resume operation (after a 3 minutes cool down period) in the MANUAL mode and maintain room temperature according to the previous setting temperature you've selected in case of manual operation before power interruption, the initial setting temperature (60°F) in case of automatic operation before power interruption.
When the heater resumes operation, The Display Window will show 88:88 indicating the need to reset the clock and the day of the week for automatic operation.

CHILD LOCK:
NOTE: The CHILD LOCK will help to prevent accidental operation as well as small children from altering controls.

To operate the CHILD LOCK simply hold the "CHILD LOCK" Button down for 3 seconds, or until you hear two short beeps. The function is activated immediately and the "CHILD LOCK" Light will illuminate.
To deactivate the CHILD LOCK simply hold the "CHILD LOCK" Button down for 3 seconds, or until you hear two short beeps. The "CHILD LOCK" Light will go out.
The lock can be deactivated at any time in this way.

During normal operation the CHILD LOCK may be activated and all controls other than the OFF switch will be locked. Deactivating the lock releases the controls. If the lock is activated while the heater is turned OFF, then all functions will be locked. If the heater is Turned OFF while the CHILD LOCK is activated, if cannot be turned ON again until the lock is deactivated.

3-15 RECOVERY FROM OVERHEAT CONDITION

The Monitor is protected against damage resulting from an overheat condition by two 115°C automatic reset thermostats.
In the event of an overheat the thermostats are triggered to cut off the flow of kerosene to the Burner Pot, the flame is extinguished automatically, and user is alerted to the overheat condition by indicating the code "E14" in the display window.
To recover from an overheat condition, proceed as outlined below:

STEP1: Turn OFF Heater

STEP2: Allow Monitor Heater to cool

NOTE: Be sure that heater is cool to touch.

A period of 30 to 45-minutes should be sufficient to permit heater to cool completely.

STEP3: Unplug Heater
Disconnect heater power cord from wall outet.

STEP4: **Check for Cause of Overheating**

NOTE: **Overheating is usually caused by objects that impede free air circulation.**

Look for debris and other obstructions at front of heater, at Circulation Fan at rear of the heater; and at Flue Pipe tip outside dwelling.

STEP5: **Remove Front Cover and Louver Assembly.**

STEP6: **Clean Heater Interior.**

⚠ WARNING:

BEFORE PROCEEDING TO CLEAN HEATER, BE SURE THAT HEATER INTERIOR IS COOL ENOUGH TO TOUCH.

With a clean, lint-free, damp rag or other appropriate cleaning material, wipe up all dust, dirt and debris from exterior of cabinet, including exterior of Combustion Chamber and Heat Exchanger.

STEP7: **Replace Louver Assembly and Front Cover.**

STEP8: **Reconnect Monitor Heater Power Plug to the Wall Outlet.**

STEP9: **Turn Heater ON**

STEP10: **Reprogram Heater Microprocessor**

STEP11: **Select Mode of Operation**

CAUTION: **If after the completion of recovery procedure, the heater overheats again, something is wrong!**

Do not operate heater until problem has been diagnosed and corrected.

3-16 RECOVERY FROM BLOWN FUSE MOVE TO TOP OF NEXT COLUMN

All electrical components of the Monitor heater protected against power overloads and electrical malfunctions by a 2-amp fuses and a 10-amp fuse. Should a fuse blow, the recovery procedure in outlined below:

STEP1: **Turn Monitor OFF**

STEP2: **Unplug heater**

STEP3: **Remove Front Cover.**

STEP4: **Remove Louver Assembly.**

STEP5: **Locate and replace fuse(s) Replace fuse with same type and rating never oversize fuse.**

STEP6: **Reattach front cover (Be sure that the connector is connected to the printed circuit board.)**

STEP7: **Reattach Louver Assembly and Front Cover.**

STEP8: **Plug heater power cord into wall outlet.**

STEP9: **Turn Monitor ON**

STEP10: **Reprogram heater**

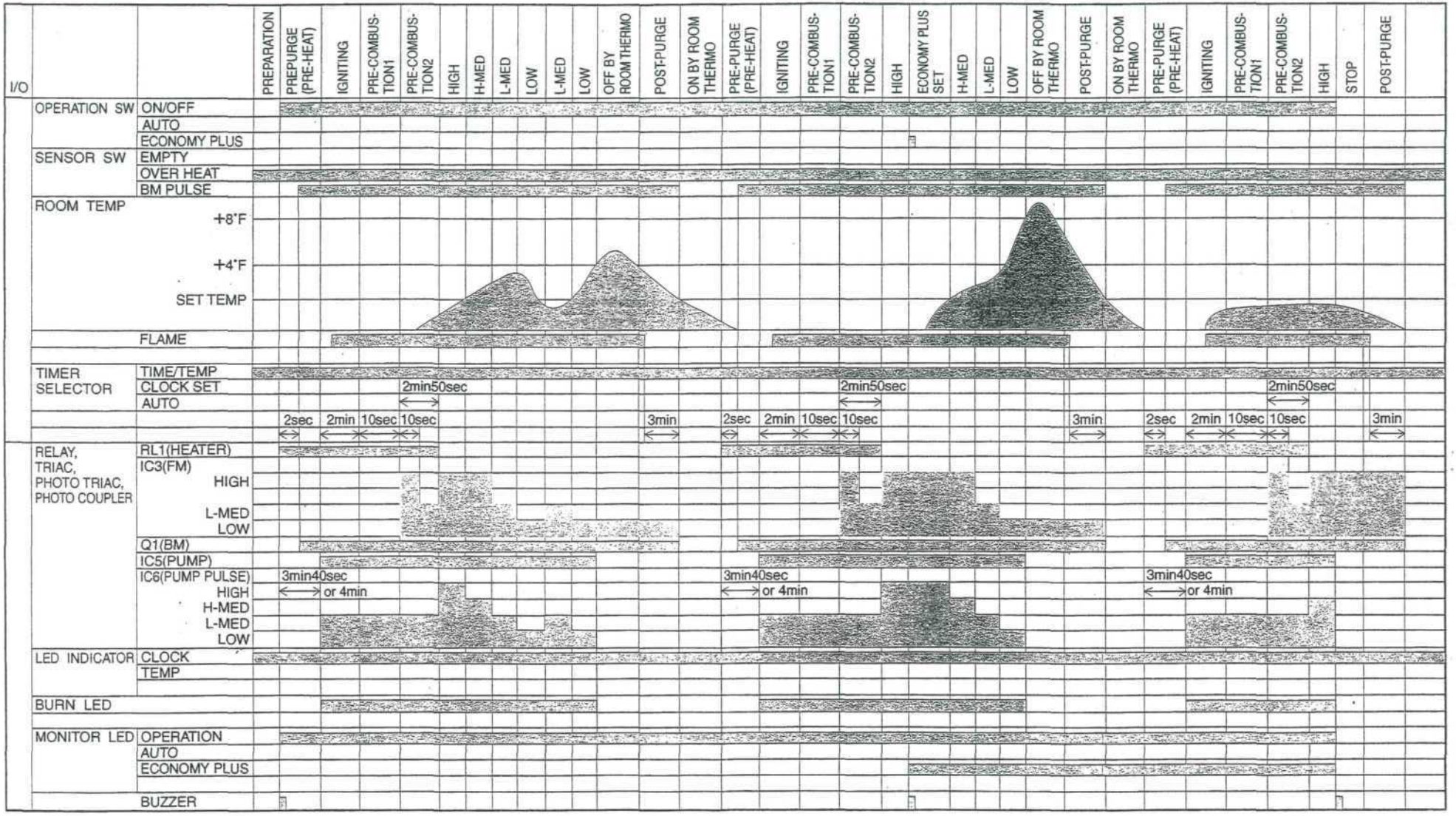
STEP11: **Program Automatic operation cycles (if applicable)**

STEP12: **Select Automatic operation (if applicable)**

Should fuse blow again, unit should be checked for shorted component failure, or PWB failure.

3-17 OPERATION CONTROL SYSTEM

M-2400/M-2200 OPERATION TIMING CHART



4-1 INTRODUCTION

Heater maintenance is divided into two classifications; periodic maintenance is required to maintain the heater in good operating condition; corrective maintenance is necessary to repair a malfunction.

4-2 PERIODIC MAINTENANCE

The Maintenance Schedule provided in Table 4-1 describes the tasks that must be performed periodically in order to sustain the efficiency of the Monitor Heating Systems.

At the time of the demonstration or installation, heater maintenance should be discussed with the user; emphasize that a clean heater and proper fuel are the keys to optimum heater operation and performance.

Table 4-1 SUGGESTED MAINTENANCE ACTIVITIES

Activity	Material	Remarks
Check all fuel pipes for leaks and loose connections	3/8" OD copper tubing	Fuel piping must be secure and free of leaks, Replace tubing when necessary.
Inspect exhaust piping for leaks or loose connections		All exhaust pipes must be covered by a cloth insulation cover. If cloth cover shows signs of discoloration at joints, check o-rings.
Check fuel for water and/or other contamination.		Fuel color should be clear, whether it's crystal clear or dyed red it still should look clear not cloudy. See Corrective Maintenance procedure paragraph 4-9.
Check and or replace fuel filter at tank if dirty check and clean constant level valve strainer, if dirty drain constant level valve, if dirty check and clean strainer on internal fuel pump. Inspect fusible link valve input fitting if used. Clean only if necessary verify heater in level.		
Inspect flue pipe for obstruction or corrosion. High sulfur fuels can produce holes in exhaust portion of flue pipe, especially in extreme cold areas, where flue pipe condensation occurs.		If blocked, clean and vacuum. If corroded badly, replace.
Inspect electrical wiring for cracks, signs of deterioration, bare wires and/or loose connectors	⚠ WARNING:	**UNPLUG HEATER BEFORE PROCEEDING. HEATER MUST ALSO BE COOL BEFORE STARTING.**
Clean heater	Clean, lint-free cloth and a mild non-abrasive household cleaning agent. USE ONLY NON-PETROLEUM DISTILLATE CLEANERS.	Wipe down exterior of heater cabinet. Vacuum heater interior (if necessary).
Clean Air Circulation Fan (Monthly)		Vacuum fan cage. Wipe fan blades.
Inspect air piping for leaks or loose connections. Inspect rubber Air Hose at rear of heater.		Look for cracks, wear, or signs of deterioration; replace if necessary.
Clean fuel constant level Valve filter. Inspect fusible link Valve input fitting. Clean only if necessary, Verify that heater is level.	Clean Kerosene	Refer to paragraph 4-5. Procedure is described in paragraph 4-6. Check Leveling Guide.

Activity	Material	Remarks
Inspect Combustion Ring, Flame Sensor Rod, Baffle, and Burner Cloth.(Suggested frequency every 3 years).		Clean all carbon deposits. Replace if excessively worn, warped, or cracked. **NOTE:** If any gaskets are torn when Components are removed, the gasket must be replaced.
Clean Combustion Chamber (every 3 years)		Vacuum all carbon deposits from interior of chamber.
Inspect air holes in Burner Pot		Use a small, stiff brush or a short length of soft copper wire to clean any blocked holes. A glass beater works well if available.
Clean Igniter		Scrape any carbon deposits from igniter.
Check air piping that interconnect Combustion Blower and Air Pressure Switch.		Replace air piping that is worn, broken or brittle.
Check for carbon build up in fuel inlet going into burn chamber (every 3 years) Check for carbon residue at burner end of fuel line (every 5 years)		Disconnect copper fuel piping from burn chamber and clear fuel inlet line by reaming with a solid piece of wire(such as copper,bailing wire,or coat hanger) which should be able to go in approximately 3" without obstruction. The fuel line can be checked and cleaned with a thinner piece of wire. **NOTE:** Removing and retightening burner fuel connection must be done when the burner cools down completely. If it is done when the burner is hot, the welding on the fuel joint may break. Fixing torgue for nut;30～40kg·cm(26～35lb·in)

4-3 INSPECT EXHAUST/AIR PIPING

Verify that all exhaust and air pipes are free of leaks and loose connections, as specified below:

STEP1: Remove Protective Cloth

Remove cloth insulation cover(s) from all exhaust pipes.

STEP2: Inspection of Exhaust/Air Piping

A. Visually inspect both air and exhaust piping for obvious cracks, leaks, or loose connections. Black carbon deposits may be evidence of these leaks, and o-rings may need to be replaced.
B. Be sure that all pipes are installed tightly and securely, especially at joints.
C. Turn heater ON.
D. Carefully apply a small amount of soapy water (with a paint brush) to the surface areas of the air/exhaust piping.

   Any leaks that may exist will be readily identified by the appearance of bubbles.

STEP3: Return to Operating Condition

A. Turn heater OFF.
B. Dry all pipes with paper towels.
C. Repair any leaks that have been found (if necessary, replace the tubing).
D. Replace cloth insulation covers.

4-4 VERIFY IGNITER OPERATION

Visually inspect Igniter Operation

⚠ WARNING:

HEATER IS OPERATIONAL DURING THIS INSPECTION. AVOID DIRECT CONTACT WITH ANY HEATED OR ELECTRICAL COMPONENT.

STEP1: Prepare for Inspection

Remove Front Cover and Louver Assembly.

STEP2: Visual Inspection

A. Turn heater ON.

B. Look (downward) through window on the Combustion Chamber. Verity that igniter is glowing.

If igniter does not glow, something is wrong. Refer to the Troubleshooting Chart in Section 6 of this Service Manual to diagnose the problem.

C. An alternate inspection is to feel the igniter cover after the unit has been in the ignition stage for about 5 minutes. It should be warm.

CAUTION: If igniter is broken,do not operate the "ON/OFF" switch button repeatedly.

STEP3: Reassembly of Heater

Turn the heater OFF and replace the Louver Assembly.

4-5 CLEAN FUEL CONSTANT LEVEL VALVE FILTER

Note: Use a quality fuel filter at the tank to minimize need for cleaning constant level valve filter, A water separate type filter works well, and avoid felt type filter elements.

Contaminants are trapped by the filter to prevent them from clogging the Fuel Constant Level Valve.

The filter, itself has a great number of small pores. Whenever a filter is torn or disfigured (enlarged pores), it should immediately be replaced.

Inspect and clean the filter as indicated by the procedure below:

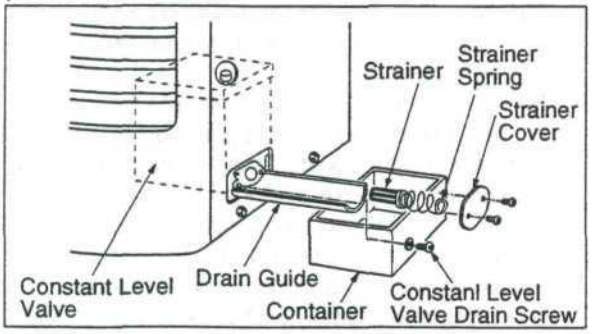


Figure 4-1 CLEAN FUEL CONSTANT LEVEL VALVE

⚠ WARNING:

CLOSE SHUT-OFF VALVE OF THE EXTERNAL FUEL TANK TO AVOID DRAINING ALL FUEL FROM TANKS.

NOTE: Power should be OFF during the performance of this procedure.

STEP1: Disassembly

A. Using a phillips head screwdriver, unscrew the screws holding the rounded diamond-shaped cover plate at the bottom of the Fuel Constant Level Valve. Remove the cover plate.

NOTE: Position a six inch U shaped piece of metal or cardboard under strainer cover to drain fuel into a pan.

B. Carefully remove the rubber gasket which is located behind the cover plate.

STEP2: Inspection and Cleaning

A. Pull the filter straight out of the fuel reservoir.

B. If the filter is dirty (but undamaged), rinse the filter in fresh, clean kerosene to remove all particles. Replace damaged filters.

C. To drain off upper portion of fuel constant level valve, back out phillips head screw which is located slightly above and to the left of filter cover plate. (See Fig4-1)

D. If upper portion drain is dirty or containing water, then remove pump and inspect and clean its screen.

STEP3: Reassembly

A. Push the (new or cleaned) filter back into the bottom of the fuel reservoir.

B. Replace both the rubber gasket and the cover plate. (Take care to properly align the screw holes in the gasket and cover plate).

C. Wipe up any spilled fuel.

4-6 CLEANING FUSIBLE LINK VALVE INTAKE

(In case of the Fusible Link Valve is mounted)

At periodic intervals, the fitting on the Fusible Link Valve should be cleaned to prevent any accumulation of foreign materials from clogging the inlet. This is accomplished as follows:

⚠ WARNING:

UNPLUG THE HEATER. POWER TO THE HEATER SHOULD BE OFF DURING THE PERFORMANCE OF THIS PROCEDURE.

STEP1: Close off Fuel Supply

A. Shut off fuel at the Storage Tank.
B. Manually turn handle to close Fusible Link Valve.

NOTE: Place paper towels underneath the Fusible Link Valve to catch any spilled fuel.

STEP2: Clean Valve

A. Loosen hex nut on Fusible Link Valve inlet fitting at rear of the heater. Disconnect the copper tubing which delivers the fuel from the storage or the fuel sump tank.
B. Using a small, straight piece of wire carefully and slowly ream-out the inlet fitting on the Fusible Link Valve.

Avoid scratching the inside wall of the fitting.

With a cotton swab, wipe the interior area of the inlet fitting.

STEP3: Reconnect Fuel Line

A. Reconnect the copper tubing to the intake fitting and tighten the hex nut.
B. Turn ON fuel at Fusible Link Valve and at storage tank.
C. Check for leaks.

4-7 CORRECTIVE MAINTENANCE

The two procedures below are remedies for very generalized types of operating difficulties.

4-8 REPLACEMENT OF FUSES

A short circuit or similar electrical malfunction could cause the fuse to blow. Troubleshoot the cause of the blown fuse.

Replace the fuse as follows:

⚠ WARNING:

DO NOT REPLACE FUSE WHILE POWER IS ON.

STEP1: Removal of Fuse

A. Unplug heater. Remove Front Cover and Louver Assembly.
B. Remove the fuse from fuseholder on the Printed Circuit Board.

STEP2: Installation of New Fuse

A. Install a new fuse into the fuseholder. The fuse must be a 250-V, 2 amp or a 250-V, 10 amp type as marked on the printed circuit board. Do not use oversized fuses.
B. Replace the Louver Assembly and the Front Cover and plug the heater into the wall outlet.

IMPORTANT: Whenever the heater is unplugged, for more than 30 minutes, the microprocessor must be reprogrammed when power is restored.

4-9 FUEL CONTAMINATION

Fuel contamination is often difficult to diagnose, even though it will adversely affect heater operation and performance. The best course of action to take when fuel contamination is suspected is to examine all of the system's fuel filters, beginning with the fuel storage tank. If a Monitor Kerosene Lifter is part of the fueling system, examine and clean that unit's filter, as well as the filter located in the Fuel Constant Level Valve. When it has been determined that water or some other contaminants have infiltrated the fuel, the following action must be taken:

⚠ WARNING:

BEFORE PROCEEDING FURTHER, UNPLUG THE HEATER.

STEP1: Remove Contamination

A. Shut OFF the fuel supply at the storage tank or at the Fusible Link Valve.
B. Drain off the contaminants from the fuel storage tank. Fill with fresh, clean fuel.

STEP2: Clean the Heater

A. Clean fuel cnstant level valve filter and filter cmpartment.
B. Remove the Front Cover and Louver Assembly and Solenoid Pump on the constant level valve. Clean the Solenoid Pump filter.

STEP3: Reinstall Cleaned Components

A. Replace the components correctly and install new gasket.
B. Turn on the fuel at the storage tank and at the fusible link valve, and apply power to the heater.

If problem still exists and contaminated fuel is suspected it can be checked by

A. Shutting off the fuel supply at the storage tank and at the fusible link valve.
B. Drain off fuel at constant level valve.
C. Disconnect fuel line at back of heater and hook up a temporary tank with proven good fuel.
D. Test run heater to see if problem clears up with use of new fuel.

5-1 INTRODUCTION

Servicing is required when the Monitor Heater is not running at proper efficiency. This section covers possible causes and corrective procedures for efficiency loses.

Signs of improper heater efficiency and performance would be:

— Yellowish lazy flame
— Smoke from flue pipe exhaust
— Heavy soot and carbon build up in combustion chamber
— Lowered heat output.

5-2 MEASUREMENT OF FUEL FLOW RATE

Fuel flow rates are preset and sealed. These rates should not and we recommend they do not be readjusted.

5-3 REMOVAL OF WATER DEPOSITS AND CONTAMINANTS FROM FUEL CONSTANT LEVEL VALVE AND FUEL LINES

NOTE: Disconnect the Monitor from power supply (unplug) before proceeding.

1. Shut off valve of separate tank.
   Bend a piece of sheet metal or cardboard into a U shape and place it under the fuel constant level valve strainer cover to drain bad fuel into a 1-2 liter pan. (Figure 4-1)
   A. Remove strainer cover and drain.
   B. With strainer cover removed, inspect, clean and/or replace strainer if damaged.
   C. Remove drain port screw and drain.
   D. Replace strainer, cover and screw.
   E. Open fusible link valve or shut-off valve to refill system with fresh crystal clear kerosene.
   F. Repeat steps 1-2 until all contaminated fuel is drained off.
2. Remove fuel feed pipe from burner pot and solenoid pump, and drain fuel into pan.
3. Once lines are clear, reconnect fuel feed pipe, turn operation switch ON and start a test run.

NOTE: Removing and retightening burner fuel connection must be done when a burner cools down completely. If it is done when a burner is hot, the welding on the fuel joint may break. Fixing Torque for nut : 30～40kg·cm (26～35lb.in).

5-4 CLEANING THE BURN CHAMBER & BURNER POT M-2400

Under normal running conditions, soot will not deposit in great quantities inside the burner, and a light covering of soot will not affect the performance of the unit thus it need not be cleaned. However, if heavy soot built up does occur the unit should be opened and cleaned.

The burner is assembled using gaskets to maintain its air tightness. If these gaskets leak, the extra air can cause a serious soot problem and or exhaust gases to escape into the area being heated.

NOTE: If any gaskets are torn when components are removed, replace. Disconnect power supply to unit.

1. If cleaning is necessary, use the following method:

A. Remove Front Cover.
B. Remove Louver Assembly.
C. Remove Top cover and wire connectors.
D. Remove heat shield that covers combustion chamber.
E. Remove service panel. (Optional)
F. Remove Flame detector rod. (Optional)
G. Remove fuel piping from burn chamber.
H. Remove gniter.
I. Remove screw at top of burner cap which attached it to cabinet. Remove screw at back of cabinet from exhaust duct and remove the 1 screw holding the heat exchanger to base.
J. Remove the 6 screws holding the burn chamber to base.
K. Rock chamber back and forth lightly, raise and remove burn chamber and heat exchanger, as one assembly from unit.
L. Set chamber upside down and remove the 4 screws which secure the burner pot to the burn chamber. Pull the burner pot up and out.

2. Turn counter-clockwise to remove combustion ring. If ring does not turn, pull up slightly to loosen retaining clips.
3. Use wire brush to clean inside of combustion chamber.
   Vacuum and wipe clean with a waste cloth.
4. If tar is present on the burner bottom, remove the tar by using a flat-bladed screw driver or wire brush,then clean the area by using a vacuum cleaner etc.

NOTE: Make sure all air inlet openings are clear.

5. When cleaning the inside of the burner pot, remove the igniter and change the burner cloth by the following procebure.

NOTE: Bottom of burner pot must be clean for glue to bond the cloth to the burner.

6. Apply glue arround the burner cloth as shown in Figure 5-1.

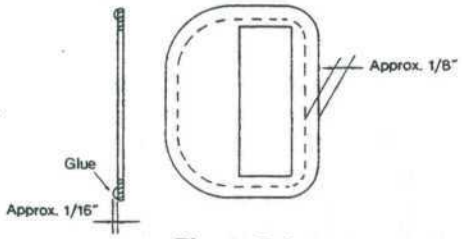


Figure 5-1

As shown in Figure 5-2 and 5-3, insert the Burner Cloth narrow side between the Nozzle Collar and the Igniter Shield, then push the Burner Cloth, using your fingers or a screw driver, so that it slips in under the Nozzle Collar. Afrerwards press and straighten out the Burner cloth so that it is glued flat and even on the Burner bottom.

NOTE: In some cases, pulling out the Fuel Nozzle and Collar may make this procedure easier. An easy out can be inserted into nozzle to help break loose and remove it.

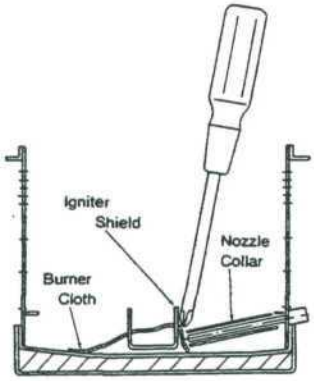


Figure 5-2

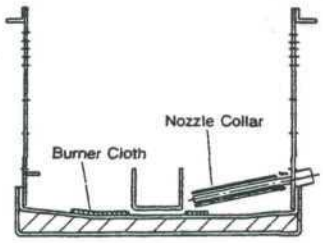


Figure 5-3

Apply glue at all 4 corners of Burner Cloth as Shown in Figure 5-4.

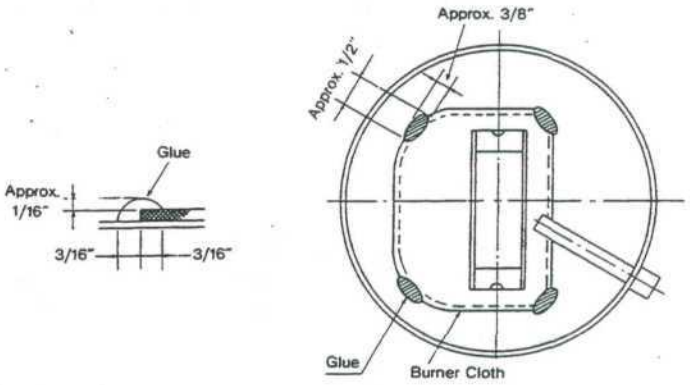


Figure 5-4

NOTE: The Burner Cloth is not symmetrical in shape, therefore make sure to place it in the correct position so that the wider side of the cloth is at left side of the Igniter Shield as shown in Figure 5-4.

7. Combustion ring may deform and deteriorate after several years use and should be cleaned and inspected before reinstallation. If combustion ring is warped, has cracked or is deteriorating excessively it should be replaced.
8. When reassembling the unit check that combustion ring is positioned with the correct side *up and is sitting squarely on all three support* pins inside the burner pot.
9. Reassemble by reversing the procedure followed during disassembly.

NOTE: Use of the economy plus feature can minimize service calls and extend component life.

NOTE: Make sure the position of flame detector rod is centered between combustion ring and burner pot before reassembling. (See Figure 5-5)

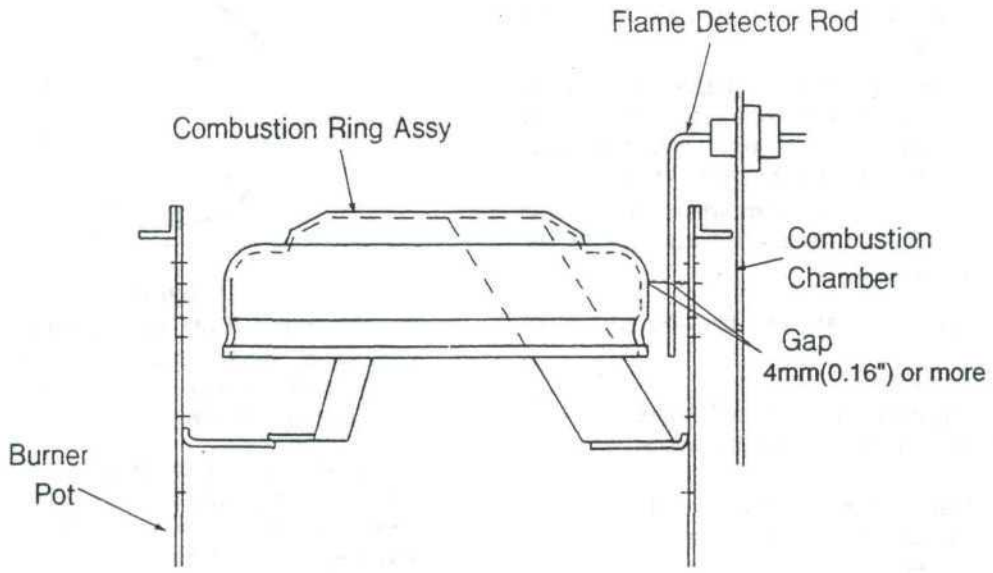


Figure 5-5

NOTE: If flame rod is sooted or has a carbon coating it can be cleaned with steel wool or a find sand paper.

For minor adjustments of flame detector rod without disassembling any components:

1. Loosen the two retaining screws about half to one full turn.
2. Tightening down on the top screw first will cock the rod outward away from the combustion ring. Tightening the bottom screw first will cock the rod inward towards the combustion ring.

5-5 CLEANING THE FUEL INLET

When cleaning the combustion chamber and the burner pot, the fuel inlet nozzle should also be cleaned. This can be done as follows:

1. Disconnect copper fuel line at burn chamber.
2. Push a piece of wire (about the same size as the I.D. of fuel inlet pipe) into the fuel inlet nozzle.
3. If obstruction is felt twist wire back and forth (to brake up soot and carbon) so that wire ultimately penetrates igniter shield.

5-6 CLEANING THE BURN CHAMBER & BURNER POT M-2200

Under normal running conditions, soot will not deposit in great quantities inside the burner, and a light covering of soot will not affect the performance of the unit thus it need not be cleaned. However, if heavy soot built up does occur the unit should be opened and cleaned.

The burner is assembled using gaskets to maintain its air tightness. If these gaskets leak, the extra air can cause a serious soot problem and or exhaust gases to escape into the area being heated.

NOTE: If any gaskets are torn when components are removed, replace. Disconnect power supply to unit.

1. If cleaning is necessary, use the following method:

A. Remove Front Cover.
B. Remove Top cover and wire connectors.
C. Remove heat shield that covers combustion chamber.
D. Remove Flame detector rod. (Optional)
E. Remove fuel piping from burn chamber.
F. Remove igniter.
G. Remove screw at top of combustion chamber which attached it to cabinet. Remove screw at back of cabinet from exhaust duct.
H. Remove the 4 screws holding combustion chamber to burn chamber.
I. Raise about 1/2" and remove combustion chamber and heat exchanger, as one assembly from unit.
J. Remove the 4 screws holding the burn chamber to base.
K. Set chamber upside down and remove the 4 screws which secure the burner pot to the burn chamber. Pull the burner pot up and out.

2. Turn counter-clockwise to remove combustion ring. If ring does not turn, pull up slightly to loosen retaining clips.
3. Use wire brush to clean inside of combustion chamber.
   Vacuum and wipe clean with a waste cloth.
4. If tar is present on the burner bottom, remove the tar by using a flat-bladed screw driver or wire brush, then clean the area by using a vacuum cleaner etc.

NOTE: Make sure all air inlet openings are clear.

5. When cleaning the inside of the burner pot, remove the igniter and change the burner cloth by the following procedure.

NOTE: Bottom of burner pot must be clean for glue to bond the cloth to the burner.

6. Apply glue (P/No.8217) on the burner bottom as shown in Figure 5-6.

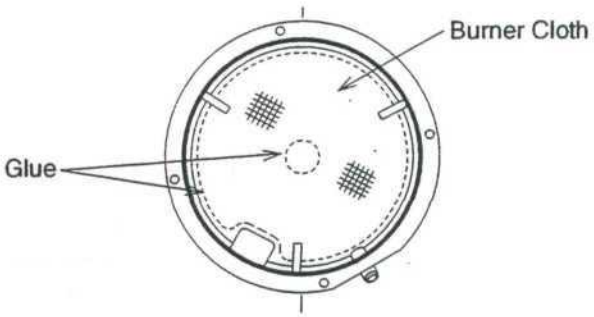


Figure 5-6

Put the burner cloth on the burner bottom, afterwards press and straighten out the burner cloth so that it is glued flat and even on the burner bottom.

7. Combustion ring may deform and deteriorate after several years use and should be cleaned and inspected before reinstallation. If combustion ring is warped, has cracked or is deteriorating excessively it should be replaced.
8. When reassembling the unit check that combustion ring is positioned with the correct side up and is sitting squarely on all three support pins inside the burner pot.
9. Reassemble by reversing the procedure followed during disassembly.

NOTE: Use of the economy plus feature can minimize service calls and extend component life.

NOTE: Make sure the position of flame detector rod is centered between combustion ring and burner pot before reassembling. (See Figure 5-7)

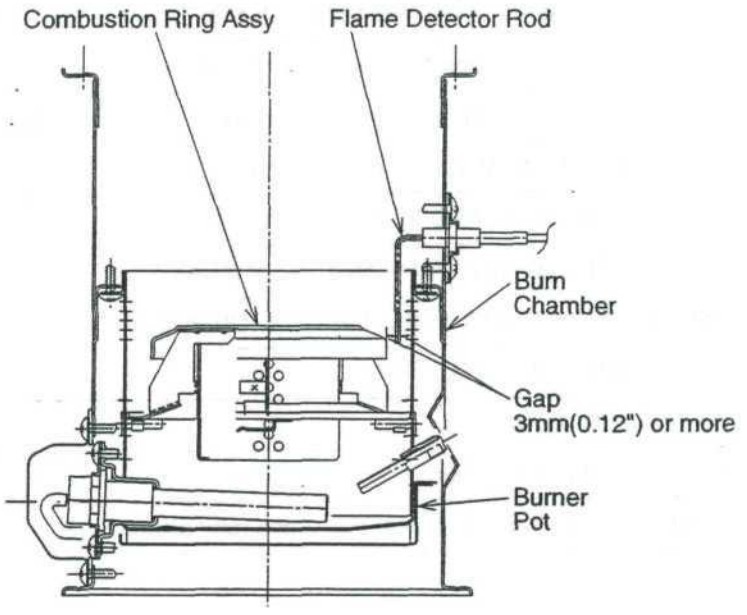


Figure 5-7

NOTE: If flame rod is sooted or has a carbon coating it can be cleaned with steel wool or a find sand paper.

For minor adjustments of flame detector rod without disassembling any components:

1. Loosen the two retaining screws about half to one full turn.
2. Tightening down on the top screw first will cock the rod outward away from the combustion ring. Tightening the bottom screw first will cock the rod inward towards the combustion ring.

5-7 CLEANING THE FUEL INLET

When cleaning the combustion chamber and the burner pot, the fuel inlet nozzle should also be cleaned. This can be done as follows:

1. Disconnect copper fuel line at burn chamber.
2. Push a piece of wire (about the same size as the I.D. of fuel inlet pipe) into the fuel inlet nozzle.
3. If obstruction is felt twist wire back and forth (to brake up soot and carbon) so that wire ultimately penetrates igniter.

Resistance values

COMPONENT	APPROX. OHMS
Igniter (connector B/B)	12.7
Power Transformer—Primary (AC 120V) "Blue" & "Blue" Connector H	141
Power Transformer—Secondary (AC 12V) "Yellow" & "Yellow" Connector R	1.9
Power Transformer—Secondary (AC 120V) "White" & "White" Connector R	590
Circulation Fan (LEAD WIRE "WHITE "&" BLACK")	124
Circulation Fan (LEAD WIRE "BLACK "&" BLUE")	270
Combustion Blower (LEAD WIRE "WHITE "&" GRAY")	41
Combustion Blower (LEAD WIRE "GRAY "&" ORANGE")	78
Thermistor (connector Q/Q, at 77° F)	10,000
Fuse 2A (read with fuse out)	0.1
Fuse 10A (read with fuse out)	0.01
Solenoid Pump (Bypass resistor at pump and read accross coil)	565

⚠ WARNING:

DISCONNECT HEATER FROM POWER SOURCE
BEFORE MAKING ANY RESISTANCE TESTS.

Component Voltage Readings

COMPONENT	READING TAKEN AT	AC	DC
Thermistor	Q on PCB Sensor disconnected		5
Thermistor	Q on PCB Sensor connected		1.5-3.2
Air Pressure Switch/ Overheat Protector Closed	Connector J	110	
Air Pressure Switch/ Overheat Protector Open	Connector J	0	
Solenoid Pump	K on PCB		pulse*
Circulation Fan High Speed	WH to BK	110	
Circulation Fan Low Speed	WH to BK	91	
Igniter	Bon PCB	110	
Power Transformer (primary side)	AC 120V	110	
Power Transformer (secondary side)	AC 120V AC 12V	120 12	
Combustion Blower High Speed	F on PCB	80	
Combustion Blower Low Speed	F on PCB	41	

*Pulse can only be measured with a high impedance digital volt meter.

Resistance values

COMPONENT	APPROX. OHMS
Igniter (connector B/B)	16.8
Power Transformer—Primary (AC 120V) "Blue" & "Blue" Connector H	141
Power Transformer—Secondary (AC 12V) "Yellow" & "Yellow" Connector R	1.9
Power Transformer—Secondary (AC 120V) "White" & "White" Connector R	590
Circulation Fan (LEAD WIRE "RED " & " BLACK")	430
Circulation Fan (LEAD WIRE "BLACK " & " YELLOW")	420
Combustion Blower (LEAD WIRE "BLACK " & " BLACK")	11.2
Thermistor (connector Q/Q, at 77°F)	10,000
Fuse 2A (read with fuse out)	0.1
Fuse 10A (read with fuse out)	0.01
Solenoid Pump (Bypass resistor at pump and read accross coil)	990

⚠ WARNING:

DISCONNECT HEATER FROM POWER SOURCE
BEFORE MAKING ANY RESISTANCE TESTS.

Component Voltage Readings

COMPONENT	READING TAKEN AT	AC	DC
Thermistor	Q on PCB Sensor disconnected		5
Thermistor	Q on PCB Sensor connected		1.5-3.2
Air Pressure Switch/ Overheat Protector Closed	Connector J	110	
Air Pressure Switch/ Overheat Protector Open	Connector J	0	
Solenoid Pump	K on PCB		pulse*
Circulation Fan High Speed	RD to BK	110	
Circulation Fan Low Speed	RD to BK	90	
Igniter	Bon PCB	110	
Power Transformer (primary side)	AC 120V	110	
Power Transformer (secondary side)	AC 120V AC 12V	120 12	
Combustion Blower High Speed	F on PCB	80	
Combustion Blower Low Speed	F on PCB	62	

*Pulse can only be measured with a high impedance digital volt meter.

TEST POINT VOLTAGE

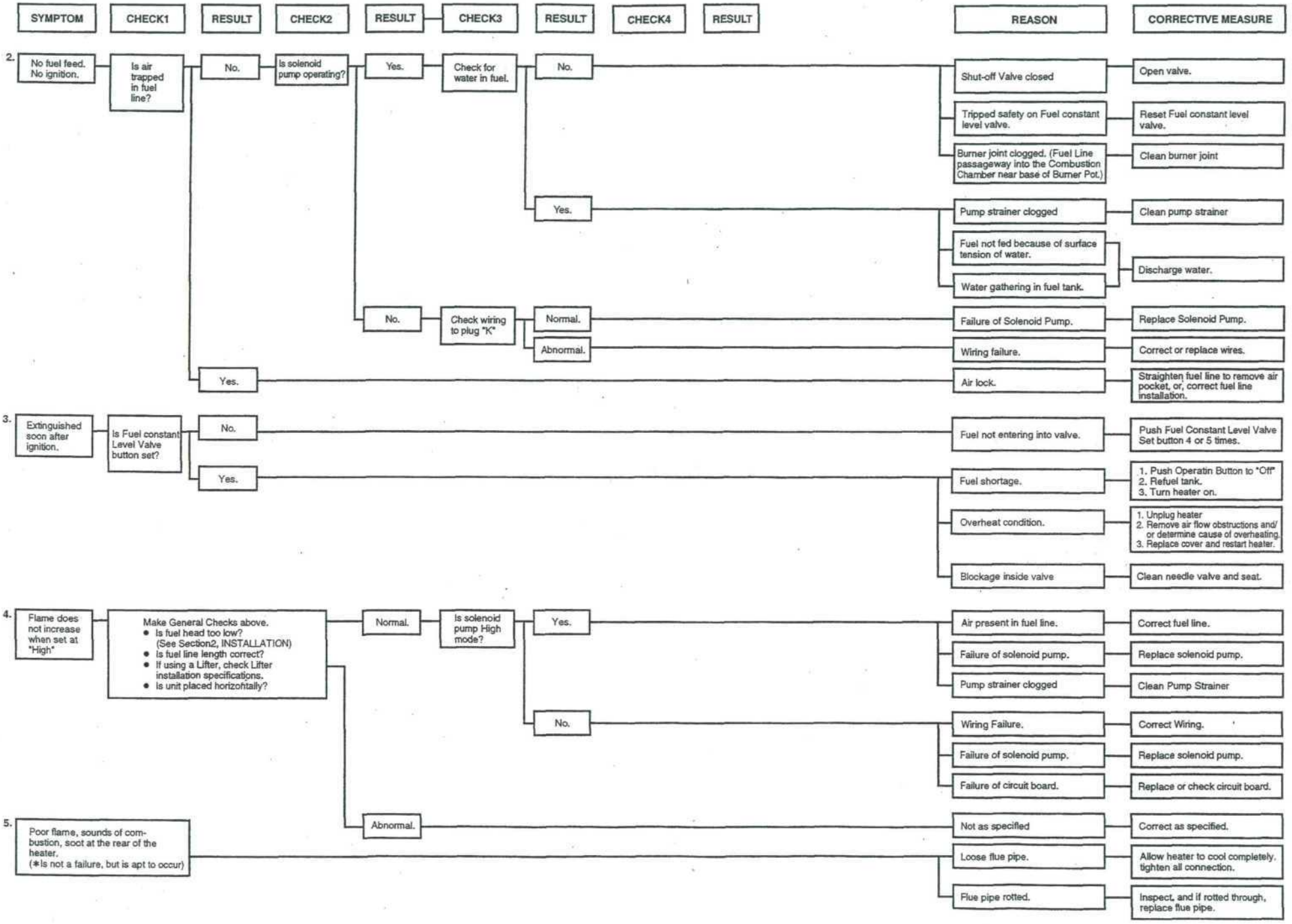
Operation Mode / Test Point	Preparation	Pre-purge Pre-heat	Igniting low med 2 min.	Pre-burning 1 (C.F.M:Off)	Pre-burning 2 (C.F.M:Low)
TP 2	5V±10%	5V±10%	5V±10%	5V±10%	5V±10%
TP 3	12V±30%	12V±30%	12V±30%	12V±30%	12V±30%
TP 4	1.5~3.2V	1.5~3.2V	1.5~3.2V	1.5~3.2V	1.5~3.2V
TP 5	pulse	pulse	pulse	pulse	pulse
TP 6	OV	OV	infinitly variable	1.2V min.	1.2V min.
TP 7	pulse at plugin	5V	5V	5V	5V

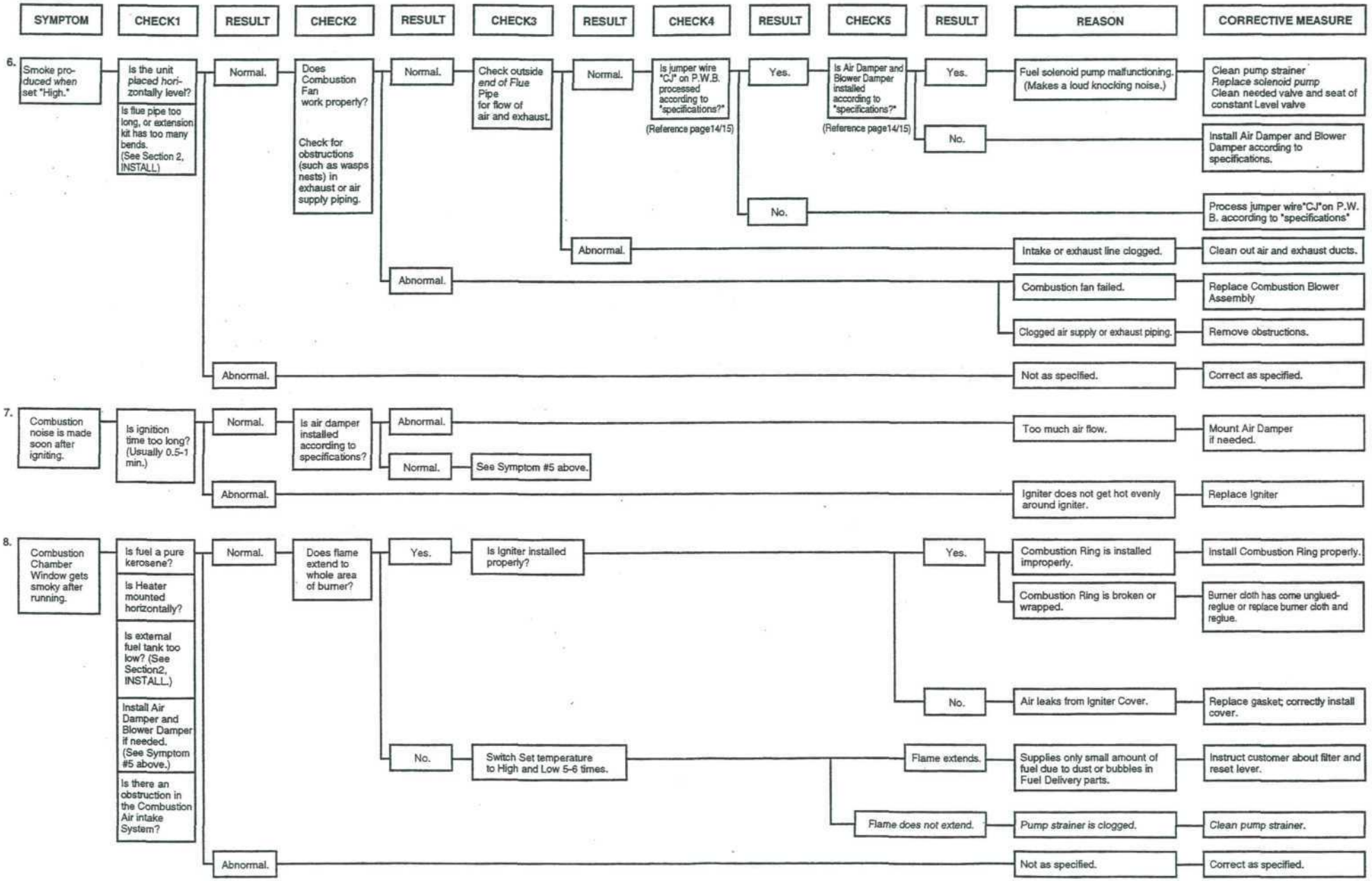
Operation Mode / Test Point	High	Medium-High	Medium-Low	Low	OFF	Post-purge	Waiting until Programmed time comes on
TP 2	5V±10%	5V±10%	5V±10%	5V±10%	5V±10%	5V±10%	5V±10%
TP 3	12V±30%	12V±30%	12V±30%	12V±30%	12V±30%	12V±30%	12V±30%
TP 4	1.5~3.2V	1.5~3.2V	1.5~3.2V	1.5~3.2V	1.5~3.2V	1.5~3.2V	1.5~3.2V
TP 5	pulse	pulse	pulse	pulse	pulse	pulse	pulse
TP 6	1.2V min.	1.2V min.	1.2V min.	1.2V min.	OV	infinitly variable	OV
TP 7	5V	5V	5V	5V	5V	5V	5V

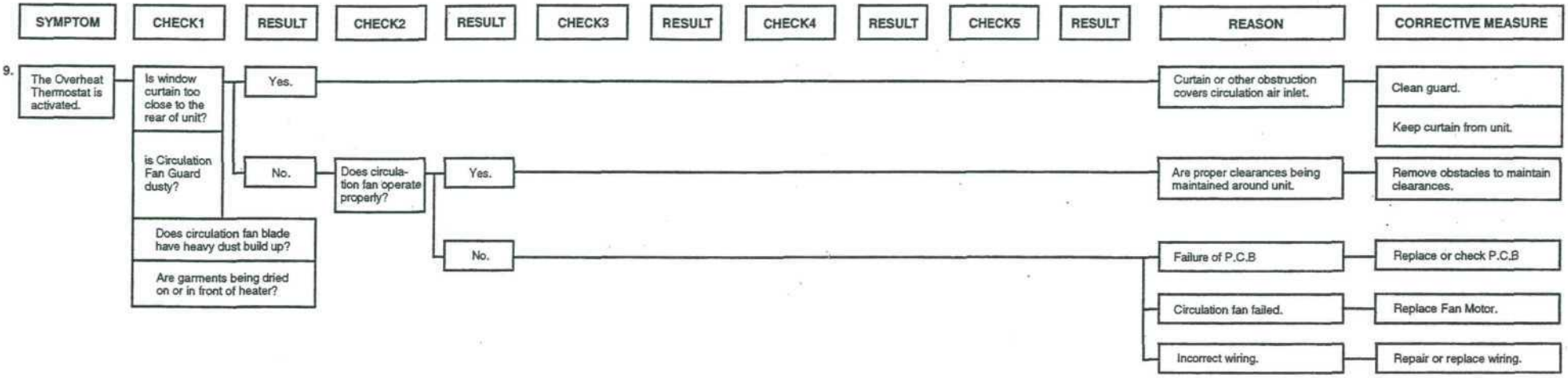
GENERAL CHECKS

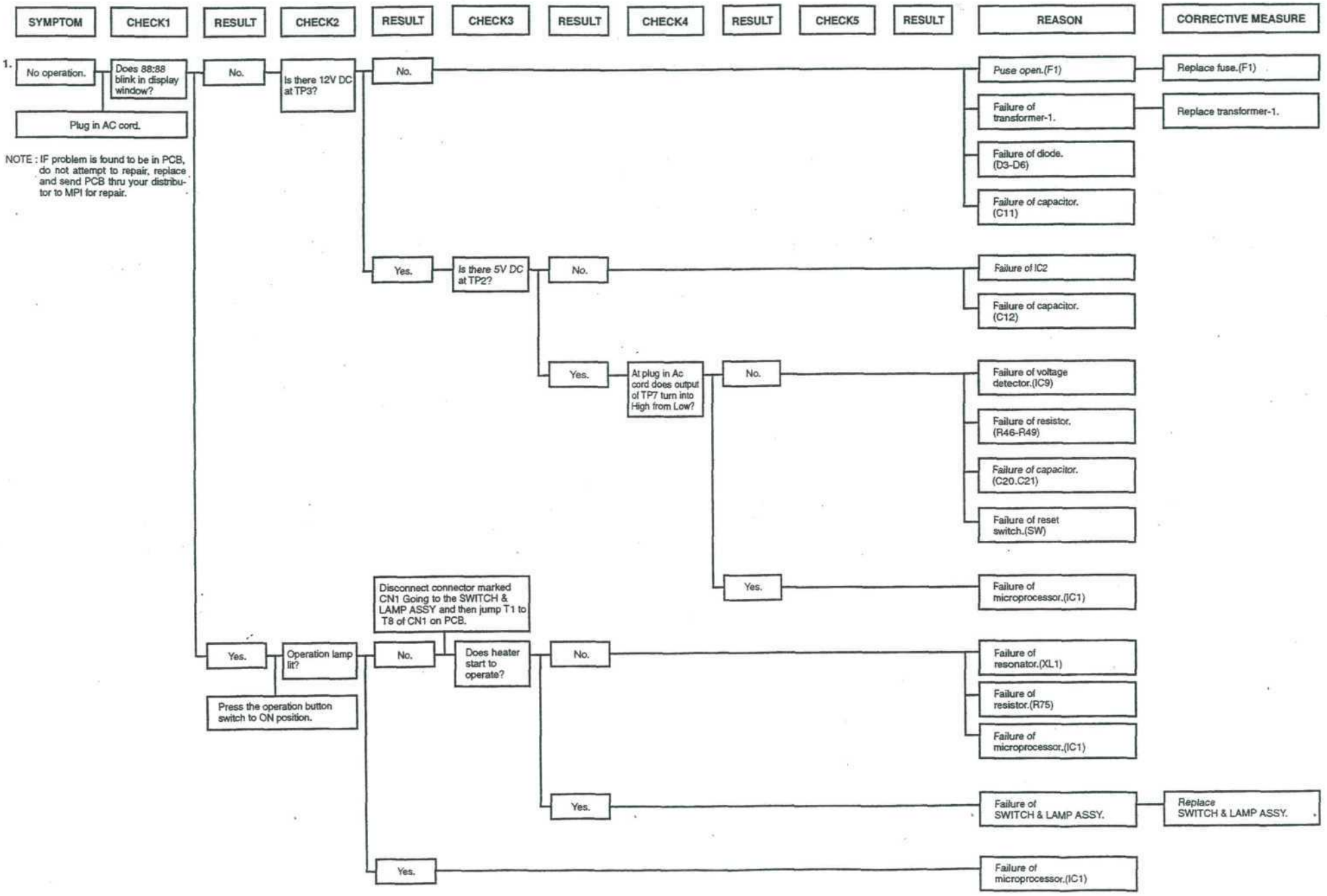
Is power available in wall outlet?
Is power Plug inserted in wall outlet?
Has there been a power interruption? (Display window shows 88:88)
Has Circulation Fan stopped?
Is fuel in tank? Tank valve open?
Has Fuel Constant Level Valve Set Lever press and release?
Is Operation Switch on?
Is peration mode on Manual?
Is set temperature in High position?
Is Shut-off Valve "open" ?
Is child lock feature engaged (disengaged)?

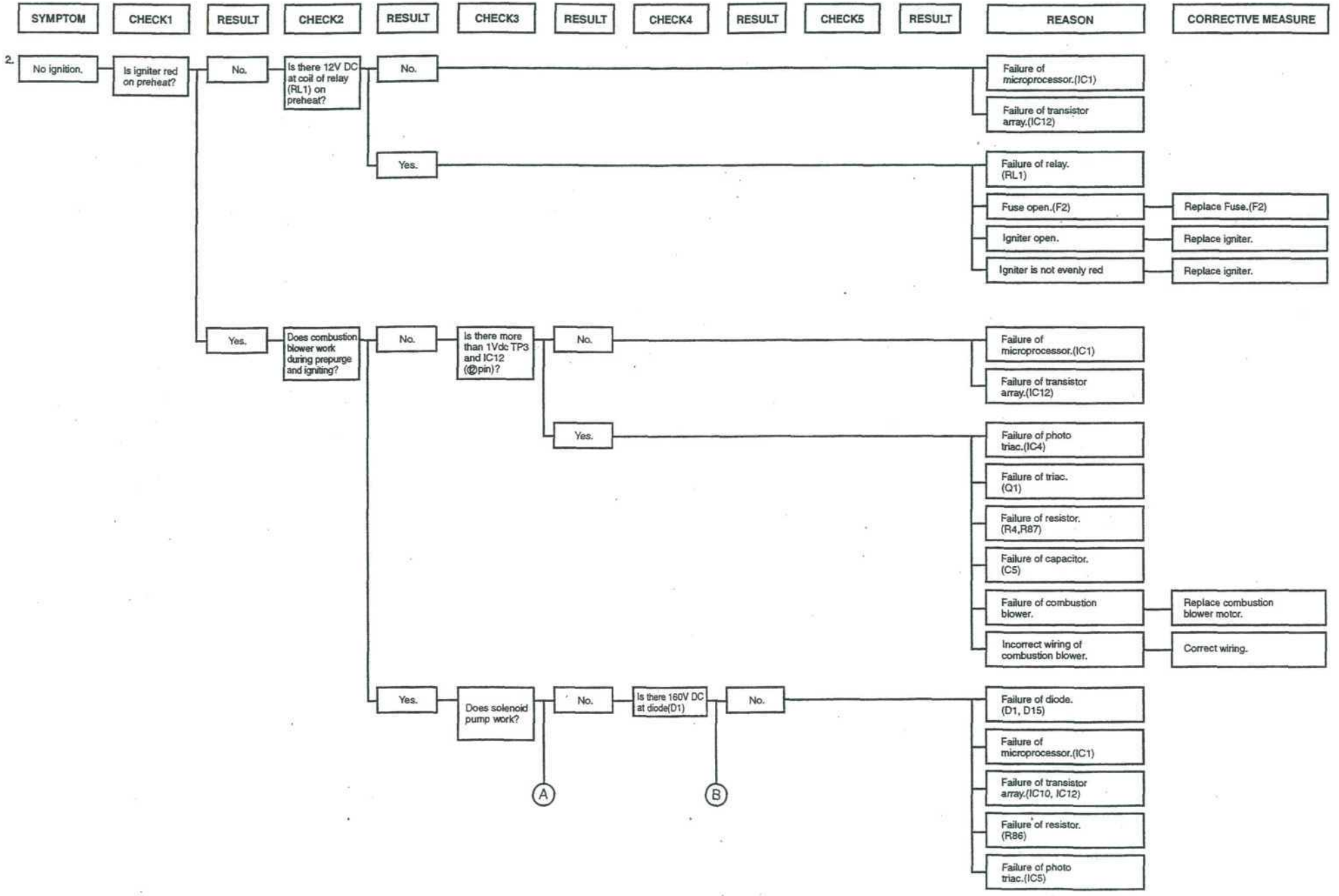
	SYMPTOM	CHECK1	RESULT	CHECK2	RESULT	CHECK3	RESULT	CHECK4	RESULT	CHECK5	RESULT	REASON	CORRECTIVE MEASURE
1.	No ignition	Operation lamp lit?	Yes.	Is igniter red? Check visually through the Combustion Chamber viewing window, of feel igniter cover (after3.5 minutes prepu-rge preheat it shuld be warm to the touch.	Yes.	Is there flame?	Yes.					Failure of Circuit Board	Replace or check Circuit Board.
												Incorrect wiring of Flame sensor or Ground.	Correct wiring.
												Flame sensor rod touches to burner parts.	Correct or Change.
												Soot adhering to combustion chamber interior.	Clean gently with brush, etc.
												Failure of solenoid Pump.	Replace Solenoid Pump.
							No.					Failure of Air Pressure Switch.	Replace Air Pressure Switch.
												Failure of Solenoid Pump.	Replace Solenoid Pump.
												Has constant level valve safety tripped.	Reset the fuel constant level valve.
												Igniter glows but not all the way around, partial Failure.	Replace Igniter
					No.	1. Operation Switch OFF, 2. Remove Igniter. 3. Disconnect wiring for Solenoid Pump. 4. Operation Switch ON.		Is there 110V or more at "B" pins on cir-cuit board?	Yes.			Failure of Igniter.	Replace Igniter.
									No.			Failure of Circuit Board.	Replace or check Circuit Board.
												Incorrect wiring.	Correct wiring.
												Is there 110V or more at plug.	Failure of Igniter relay on PCB replace board.
			No.	Is Display Win-dow lit?	No.	Check Fuse (F1).	Normal.					Failure of Circuit Board.	Replace or check Circuit Board.
							Melted.	Change fuse, plug in power cord.	Normal.			Fuse open.	Change fuse.
									Melted.			Short circuit of lead wire.	Correct or change.
					Yes.							Failure of Circuit Board.	Replace or check Circuit Board.
												Is in Auto operation mode.	Put in Manual-Burn Mode.

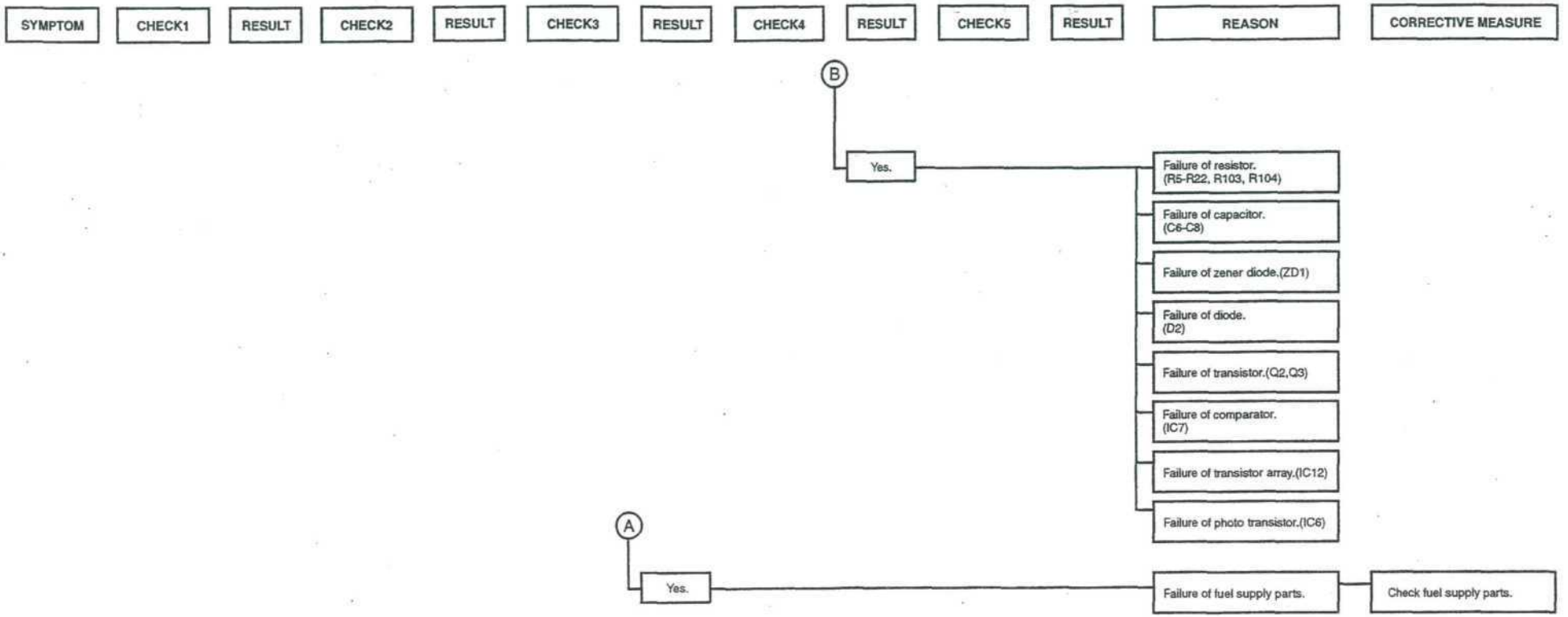

SYMPTOM
CHECK1
RESULT
CHECK2
RESULT
CHECK3
RESULT
CHECK4
RESULT
REASON
CORRECTIVE MEASURE
2.
No fuel feed. No ignition.
Is air trapped in fuel line?
No.
Is solenoid pump operating?
Yes.
Check for water in fuel.
No.
Shut-off Valve closed
Open valve.
Tripped safety on Fuel constant level valve.
Reset Fuel constant level valve.
Burner joint clogged. (Fuel Line passageway into the Combustion Chamber near base of Burner Pot.)
Clean burner joint
Yes.
Pump strainer clogged
Clean pump strainer
Fuel not fed because of surface tension of water.
Water gathering in fuel tank.
Discharge water.
No.
Check wiring to plug "K"
Normal.
Failure of Solenoid Pump.
Replace Solenoid Pump.
Abnormal.
Wiring failure.
Correct or replace wires.
Yes.
Air lock.
Straighten fuel line to remove air pocket, or, correct fuel line installation.
3.
Extinguished soon after ignition.
Is Fuel constant Level Valve button set?
No.
Fuel not entering into valve.
Push Fuel Constant Level Valve Set button 4 or 5 times.
Yes.
Fuel shortage.
1. Push Operatin Button to "Off"
2. Refuel tank.
3. Turn heater on.
Overheat condition.
1. Unplug heater
2. Remove air flow obstructions and/or determine cause of overheating.
3. Replace cover and restart heater.
Blockage inside valve
Clean needle valve and seat.
4.
Flame does not increase when set at "High"
Make General Checks above.
• Is fuel head too low? (See Section2, INSTALLATION)
• Is fuel line length correct?
• If using a Lifter, check Lifter installation specifications.
• Is unit placed horizontally?
Normal.
Is solenoid pump High mode?
Yes.
Air present in fuel line.
Correct fuel line.
Failure of solenoid pump.
Replace solenoid pump.
Pump strainer clogged
Clean Pump Strainer
No.
Wiring Failure.
Correct Wiring.
Failure of solenoid pump.
Replace solenoid pump.
Failure of circuit board.
Replace or check circuit board.
5.
Poor flame, sounds of combustion, soot at the rear of the heater.
(*Is not a failure, but is apt to occur)
Abnormal.
Not as specified
Correct as specified.
Loose flue pipe.
Allow heater to cool completely, tighten all connection.
Flue pipe rotted.
Inspect, and if rotted through, replace flue pipe.


SYMPTOM
CHECK1
RESULT
CHECK2
RESULT
CHECK3
RESULT
CHECK4
RESULT
CHECK5
RESULT
REASON
CORRECTIVE MEASURE
6.
Smoke produced when set "High."
Is the unit placed horizontally level?
Is flue pipe too long, or extension kit has too many bends. (See Section 2, INSTALL)
Normal.
Does Combustion Fan work properly?
Check for obstructions (such as wasps nests) in exhaust or air supply piping.
Normal.
Check outside end of Flue Pipe for flow of air and exhaust.
Normal.
Is jumper wire "CJ" on P.W.B. processed according to "specifications?"
(Reference page14/15)
Yes.
Is Air Damper and Blower Damper installed according to "specifications?"
(Reference page14/15)
Yes.
Fuel solenoid pump malfunctioning. (Makes a loud knocking noise.)
Clean pump strainer
Replace solenoid pump
Clean needed valve and seat of constant Level valve
No.
Install Air Damper and Blower Damper according to specifications.
No.
Process jumper wire"CJ"on P.W.B. according to "specifications"
Abnormal.
Intake or exhaust line clogged.
Clean out air and exhaust ducts.
Abnormal.
Combustion fan failed.
Replace Combustion Blower Assembly
Clogged air supply or exhaust piping.
Remove obstructions.
Abnormal.
Not as specified.
Correct as specified.
7.
Combustion noise is made soon after igniting.
Is ignition time too long? (Usually 0.5-1 min.)
Normal.
Is air damper installed according to specifications?
Abnormal.
Too much air flow.
Mount Air Damper if needed.
Normal.
See Symptom #5 above.
Abnormal.
Igniter does not get hot evenly around igniter.
Replace Igniter
8.
Combustion Chamber Window gets smoky after running.
Is fuel a pure kerosene?
Is Heater mounted horizontally?
Is external fuel tank too low? (See Section2, INSTALL.)
Install Air Damper and Blower Damper if needed. (See Symptom #5 above.)
Is there an obstruction in the Combustion Air intake System?
Normal.
Does flame extend to whole area of burner?
Yes.
Is Igniter installed properly?
Yes.
Combustion Ring is installed improperly.
Install Combustion Ring properly.
Combustion Ring is broken or wrapped.
Burner cloth has come unglued-reglue or replace burner cloth and reglue.
No.
Air leaks from Igniter Cover.
Replace gasket; correctly install cover.
No.
Switch Set temperature to High and Low 5-6 times.
Flame extends.
Supplies only small amount of fuel due to dust or bubbles in Fuel Delivery parts.
Instruct customer about filter and reset lever.
Flame does not extend.
Pump strainer is clogged.
Clean pump strainer.
Abnormal.
Not as specified.
Correct as specified.


SYMPTOM
CHECK1
RESULT
CHECK2
RESULT
CHECK3
RESULT
CHECK4
RESULT
CHECK5
RESULT
REASON
CORRECTIVE MEASURE
9.
The Overheat Thermostat is activated.
Is window curtain too close to the rear of unit?
is Circulation Fan Guard dusty?
Does circulation fan blade have heavy dust build up?
Are garments being dried on or in front of heater?
Yes.
No.
Does circulation fan operate properly?
Yes.
No.
Curtain or other obstruction covers circulation air inlet.
Clean guard.
Keep curtain from unit.
Are proper clearances being maintained around unit.
Remove obstacles to maintain clearances.
Failure of P.C.B
Replace or check P.C.B
Circulation fan failed.
Replace Fan Motor.
Incorrect wiring.
Repair or replace wiring.


SYMPTOM
CHECK1
RESULT
CHECK2
RESULT
CHECK3
RESULT
CHECK4
RESULT
CHECK5
RESULT
REASON
CORRECTIVE MEASURE
1.
No operation.
Does 88:88 blink in display window?
Plug in AC cord.
NOTE : IF problem is found to be in PCB, do not attempt to repair, replace and send PCB thru your distributor to MPI for repair.
No.
Is there 12V DC at TP3?
No.
Puse open.(F1)
Replace fuse.(F1)
Failure of transformer-1.
Replace transformer-1.
Failure of diode. (D3-D6)
Failure of capacitor. (C11)
Yes.
Is there 5V DC at TP2?
No.
Failure of IC2
Failure of capacitor. (C12)
Yes.
At plug in Ac cord does output of TP7 turn into High from Low?
No.
Failure of voltage detector.(IC9)
Failure of resistor. (R46-R49)
Failure of capacitor. (C20.C21)
Failure of reset switch.(SW)
Yes.
Failure of microprocessor.(IC1)
Yes.
Operation lamp lit?
Press the operation button switch to ON position.
Disconnect connector marked CN1 Going to the SWITCH & LAMP ASSY and then jump T1 to T8 of CN1 on PCB.
No.
Does heater start to operate?
No.
Failure of resonator.(XL1)
Failure of resistor.(R75)
Failure of microprocessor.(IC1)
Yes.
Failure of SWITCH & LAMP ASSY.
Replace SWITCH & LAMP ASSY.
Yes.
Failure of microprocessor.(IC1)


SYMPTOM
CHECK1
RESULT
CHECK2
RESULT
CHECK3
RESULT
CHECK4
RESULT
CHECK5
RESULT
REASON
CORRECTIVE MEASURE
2.
No ignition.
Is igniter red on preheat?
No.
Is there 12V DC at coil of relay (RL1) on preheat?
No.
Failure of microprocessor.(IC1)
Failure of transistor array.(IC12)
Yes.
Failure of relay. (RL1)
Fuse open.(F2)
Replace Fuse.(F2)
Igniter open.
Replace igniter.
Igniter is not evenly red
Replace igniter.
Yes.
Does combustion blower work during prepurge and igniting?
No.
Is there more than 1Vdc TP3 and IC12 (⑫pin)?
No.
Failure of microprocessor.(IC1)
Failure of transistor array.(IC12)
Yes.
Failure of photo triac.(IC4)
Failure of triac. (Q1)
Failure of resistor. (R4,R87)
Failure of capacitor. (C5)
Failure of combustion blower.
Replace combustion blower motor.
Incorrect wiring of combustion blower.
Correct wiring.
Yes.
Does solenoid pump work?
No.
Is there 160V DC at diode(D1)
No.
Failure of diode. (D1, D15)
Failure of microprocessor.(IC1)
Failure of transistor array.(IC10, IC12)
Failure of resistor. (R86)
Failure of photo triac.(IC5)
A
B


SYMPTOM
CHECK1
RESULT
CHECK2
RESULT
CHECK3
RESULT
CHECK4
RESULT
CHECK5
RESULT
REASON
CORRECTIVE MEASURE
B
Yes.
Failure of resistor. (R5-R22, R103, R104)
Failure of capacitor. (C6-C8)
Failure of zener diode.(ZD1)
Failure of diode. (D2)
Failure of transistor.(Q2,Q3)
Failure of comparator. (IC7)
Failure of transistor array.(IC12)
Failure of photo transistor.(IC6)
A
Yes.
Failure of fuel supply parts.
Check fuel supply parts.

SYMPTOM	CHECK1	RESULT	CHECK2	RESULT	CHECK3	RESULT	CHECK4	RESULT	CHECK5	RESULT	REASON	CORRECTIVE MEASURE
3. Flame failure.	Is there 1.2V DC at IC8 (⑤pin)?	No.									Failure of resistor. (R25-R28)	
		Yes.	Is there more than 1.3V DC at TP6?	No.							Failure of transformer-1.	Replace transformer-1.
											Failure of capacitor. (C15-C17)	
											Failure of resistor. (R23.R30-R32)	
				Yes.	Is there OV at IC8(①pin)?	No.	Is there 1.2V DC at IC10(⑪pin)?	No.			Failure of resistor. (R36, R78)	
											Failure of capacitor. (C33)	
											Failure of diode. (D16, D18)	
											Failure of transistor array.(IC10)	
								Yes.			Failure of resistor. (R33, R35)	
											Failure of microprocessor.(IC1)	
											Failure of wiring for flame sensor and ground.	Correct wiring.
											Incorrect installation of flame sensor rod.	Correct installation.
						Yes.					Failure of comparator.(IC8)	

FLAME ROD BYPASS CIRCUIT

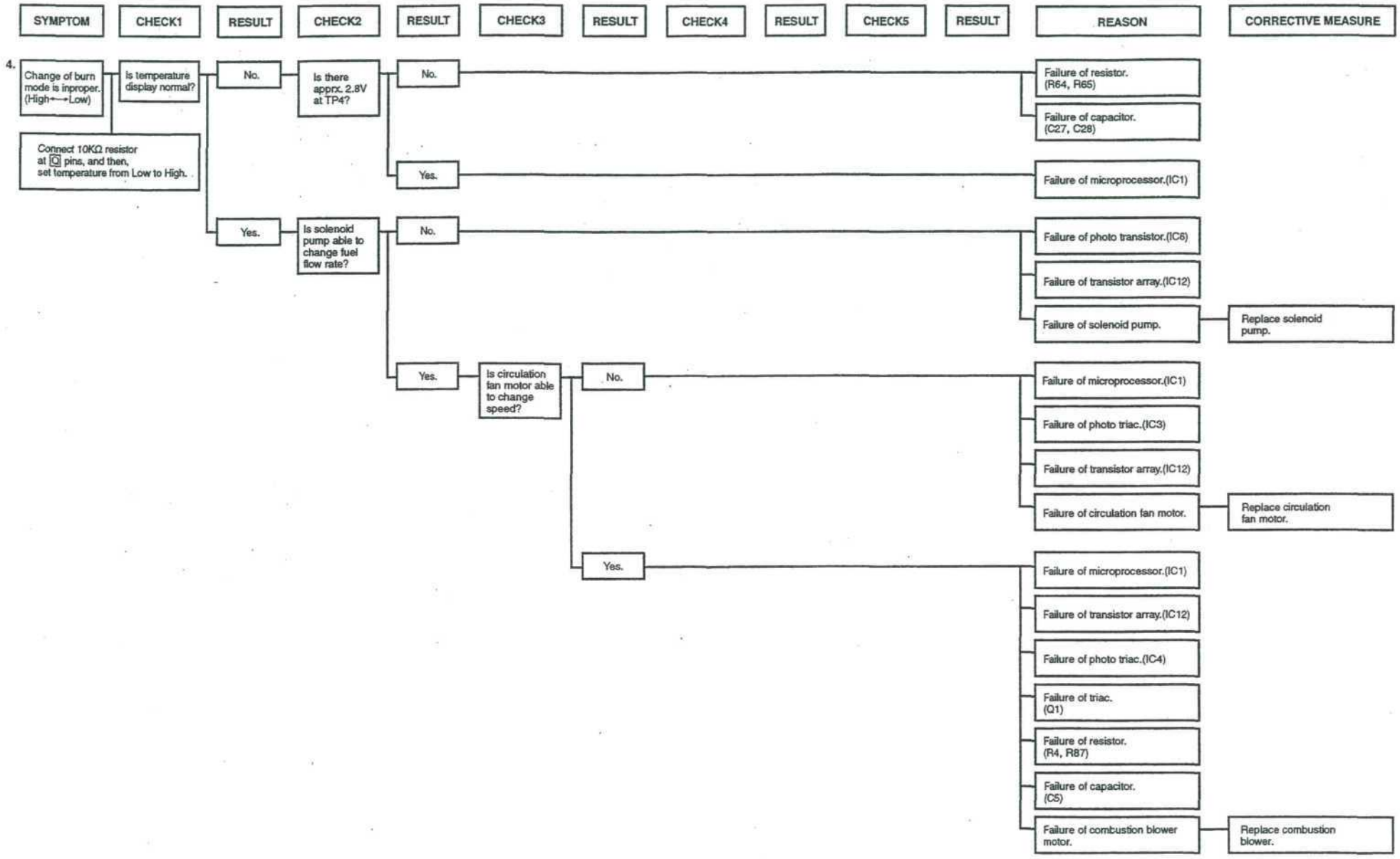
For testing purposes — A flame detector rod bypass circuit can be made up, consisting of 2 insulated alligator clips, 2-6" pieces of insulated copper wire, 1-1 ampere 400 volt diode, and 1-1/4 watt 100K OHM resistor.

These components are to be soldered together in sequence as shown in diagram below (note component and polarity).

Once the bypass circuit is made the unit is turned on, immediately after the prepurge preheat cycle; when mode light comes on, the 0 and N pins are disconnected off the PCB and replaced with the bypass circuit.

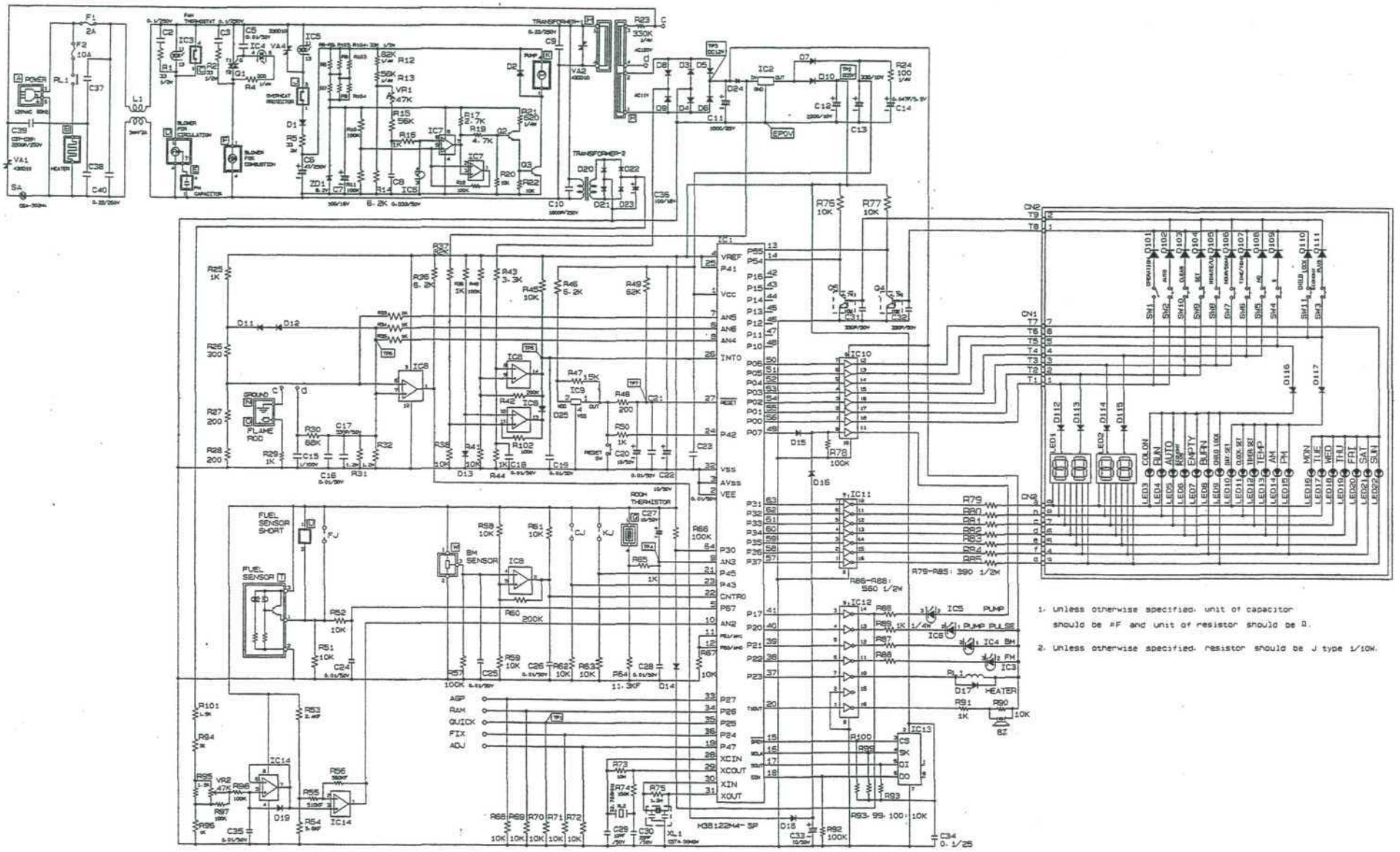
The unit should then continue functioning as though it had a good flame inside the burn chamber and service tests such as fuel flow can be checked.

(Note-WARNING, after all tests are completed, replace original flame rod wires as it is a vital safety feature.)

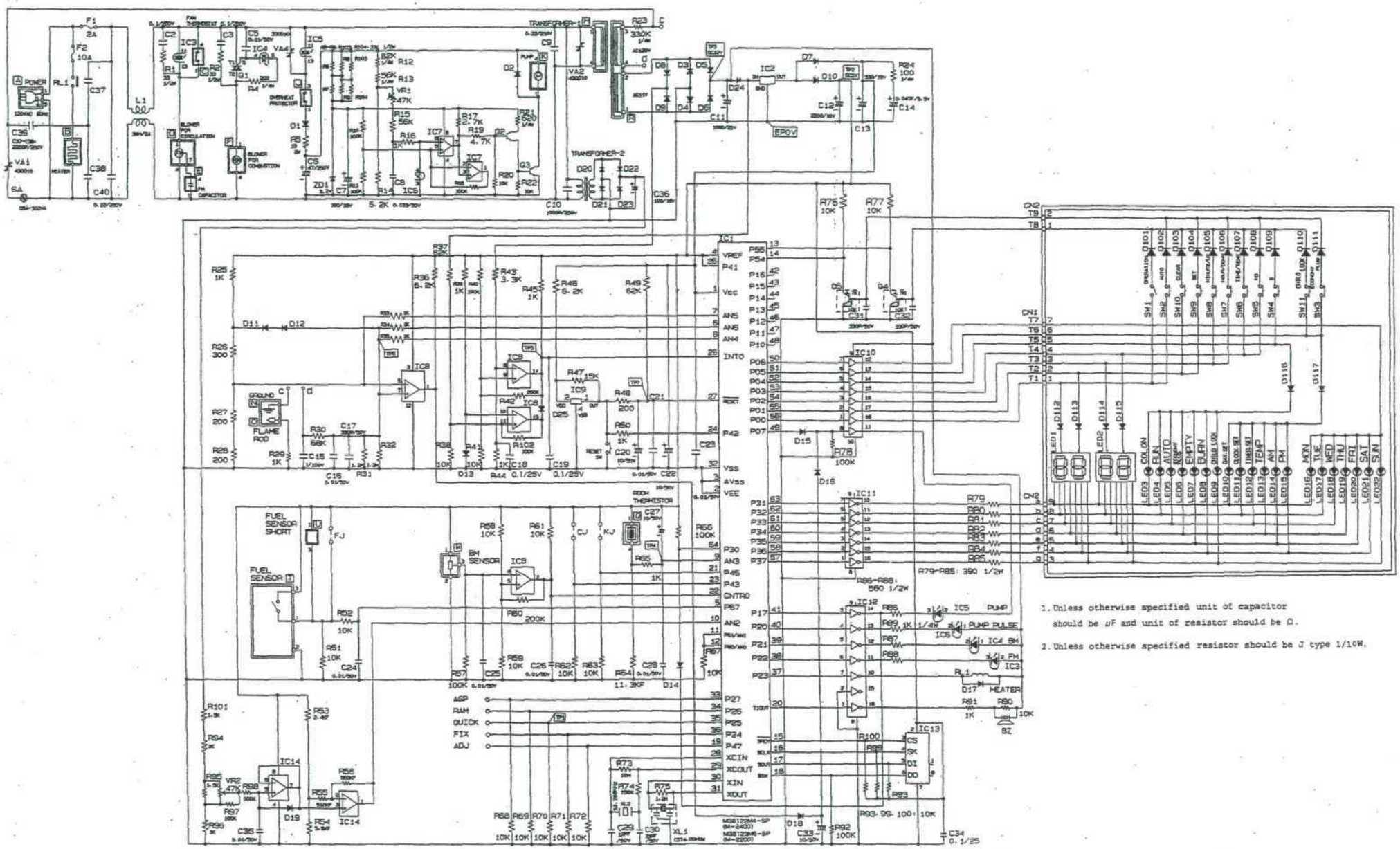

SYMPTOM
CHECK1
RESULT
CHECK2
RESULT
CHECK3
RESULT
CHECK4
RESULT
CHECK5
RESULT
REASON
CORRECTIVE MEASURE
4.
Change of burn mode is inproper. (High←→Low)
Is temperature display normal?
No.
Is there apprx. 2.8V at TP4?
No.
Failure of resistor. (R64, R65)
Failure of capacitor. (C27, C28)
Yes.
Failure of microprocessor.(IC1)
Connect 10KΩ resistor at Q pins, and then, set temperature from Low to High.
Yes.
Is solenoid pump able to change fuel flow rate?
No.
Failure of photo transistor.(IC6)
Failure of transistor array.(IC12)
Failure of solenoid pump.
Replace solenoid pump.
Yes.
Is circulation fan motor able to change speed?
No.
Failure of microprocessor.(IC1)
Failure of photo triac.(IC3)
Failure of transistor array.(IC12)
Failure of circulation fan motor.
Replace circulation fan motor.
Yes.
Failure of microprocessor.(IC1)
Failure of transistor array.(IC12)
Failure of photo triac.(IC4)
Failure of triac. (Q1)
Failure of resistor. (R4, R87)
Failure of capacitor. (C5)
Failure of combustion blower motor.
Replace combustion blower.

INDICATION OF FAILURE MODE

Digital Display	The Reason of Indication	Trouble Point
E01	At pre-purge, Flame rod is sensing flame when there should be none.	Flame sensing circuit, grounded flame rod or pinched wire.
E05	After power is turned on, power supply to the microprocessor timing circuit is incorrect.	Timer clock circuit bad or power cycles (hertz) to unit above or below acceptable levels.
E06	At starting of operation, the circuit to drive photo triac of Solenoid Pump is malfunctioning.	Solenoid Pump control circuit has a malfunction.
E08	Revolutions per minute of Combustion blower is malfunctioning.	Combustion blower or Combustion blower control circuit has a malfunction.
E 13	No ignition.	Failure of Igniter, Solenoid Pump or circuit Board. Incorrect wiring or flame rod touches to burner parts. Air pressure switch or overheat open.
E 14	Flame failure.	There are obstacles at circulation air inlet or outlet. Fan cage is clogged with dust. Inadequate fuel supply.
E 15	Power supply voltage too low.	Voltage too low or Power detector circuit has a malfunction.
E 16	Load failure of Combustion blower motor.	Flue Pipe is restricting air flow.

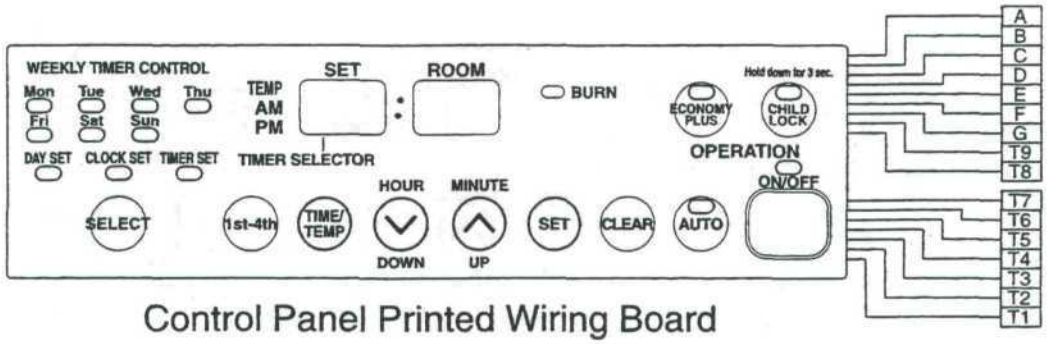

1. Unless otherwise specified, unit of capacitor should be μF and unit of resistor should be Ω.
2. Unless otherwise specified, resistor should be J type 1/10W.

Monitor 2400 : Room Heater products since February 2004
Monitor 2200 : All Room Heaters



1. Unless otherwise specified unit of capacitor should be μF and unit of resistor should be Ω.
2. Unless otherwise specified resistor should be J type 1/10W.

CONNECTION OF LEAD WIRES



Control Panel Printed Wiring Board

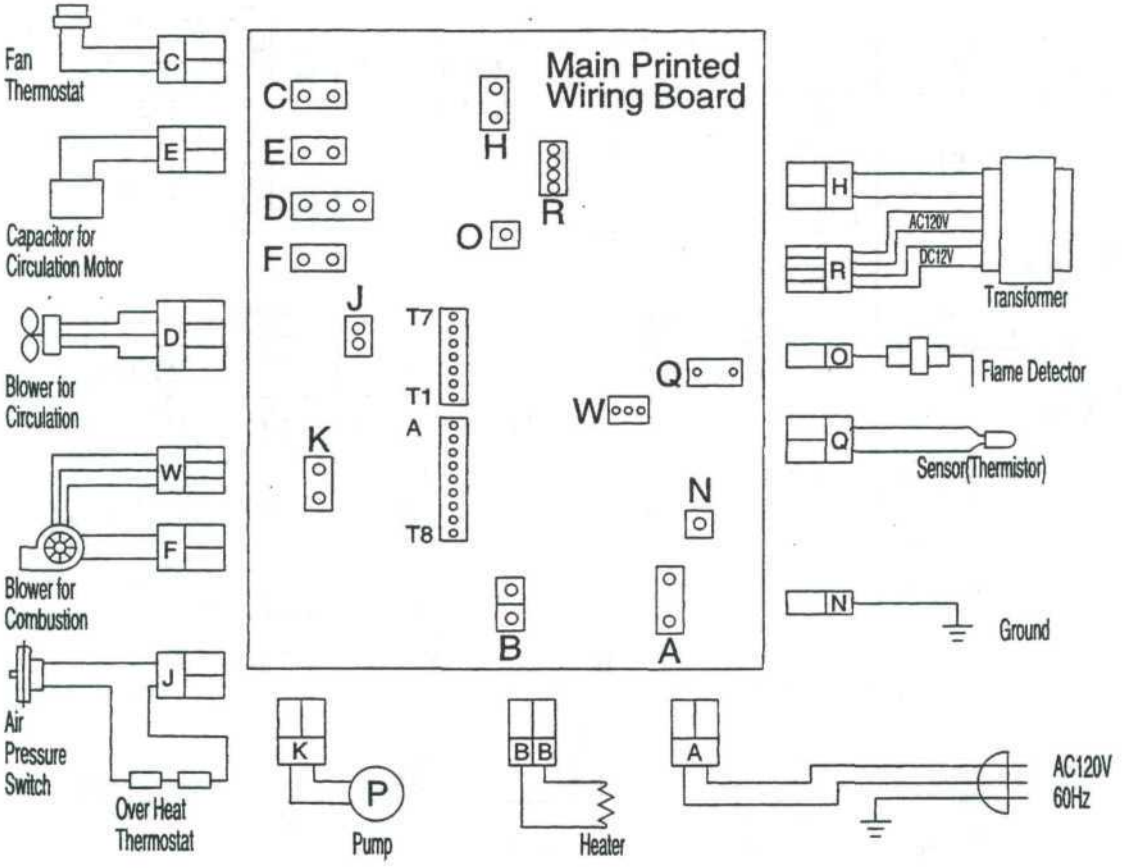

Fan Thermostat
Capacitor for Circulation Motor
Blower for Circulation
Blower for Combustion
Air Pressure Switch
Over Heat Thermostat
Main Printed Wiring Board
C E D F J K H R O T7 T1 A T8 Q W N B A
H R AC120V DC12V Transformer
O Flame Detector
Q Sensor(Thermistor)
N Ground
K P Pump
B B Heater
A AC120V 60Hz

Figure 7-1 Monitor 2400

CONNECTION OF LEAD WIRES

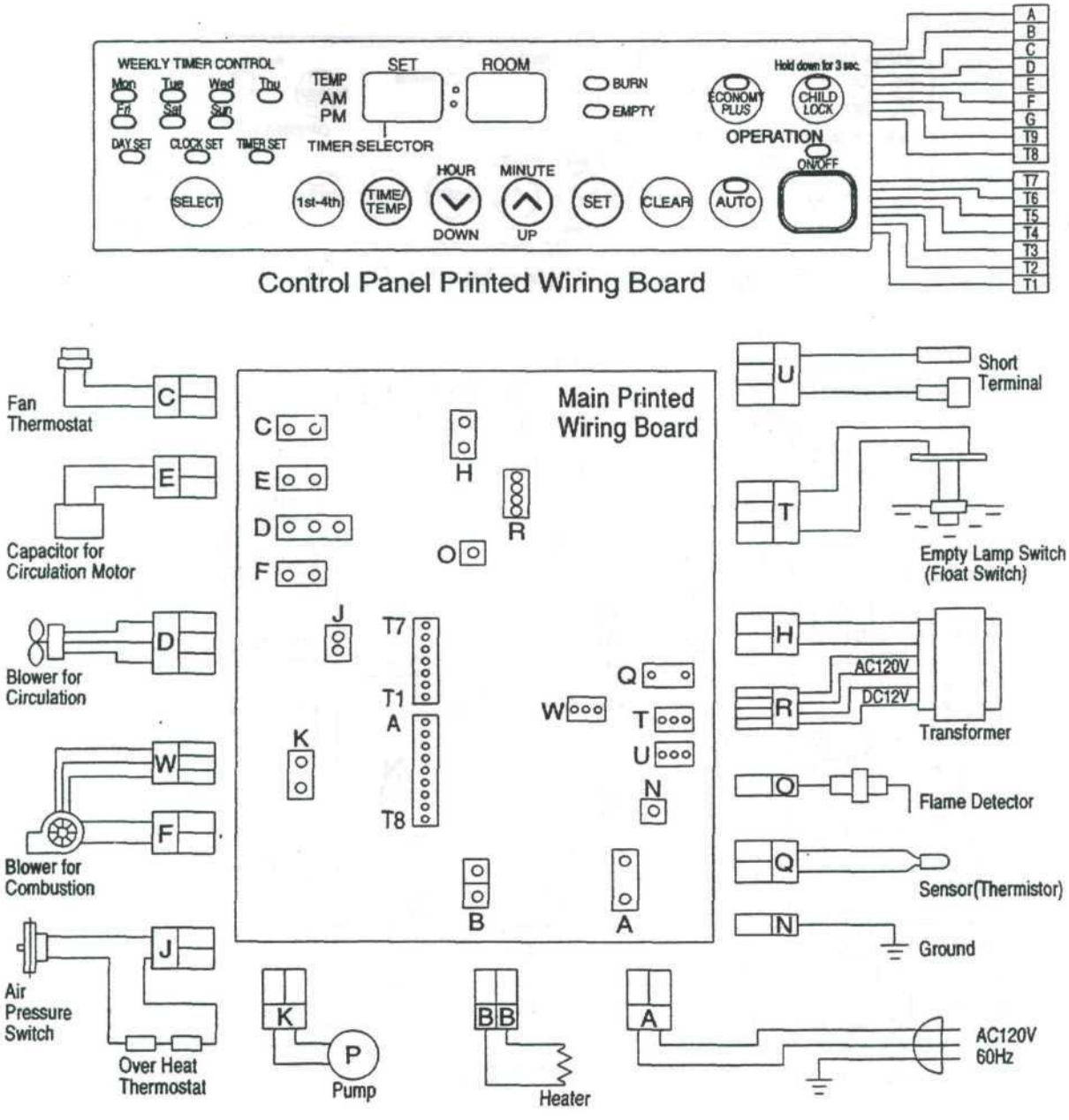
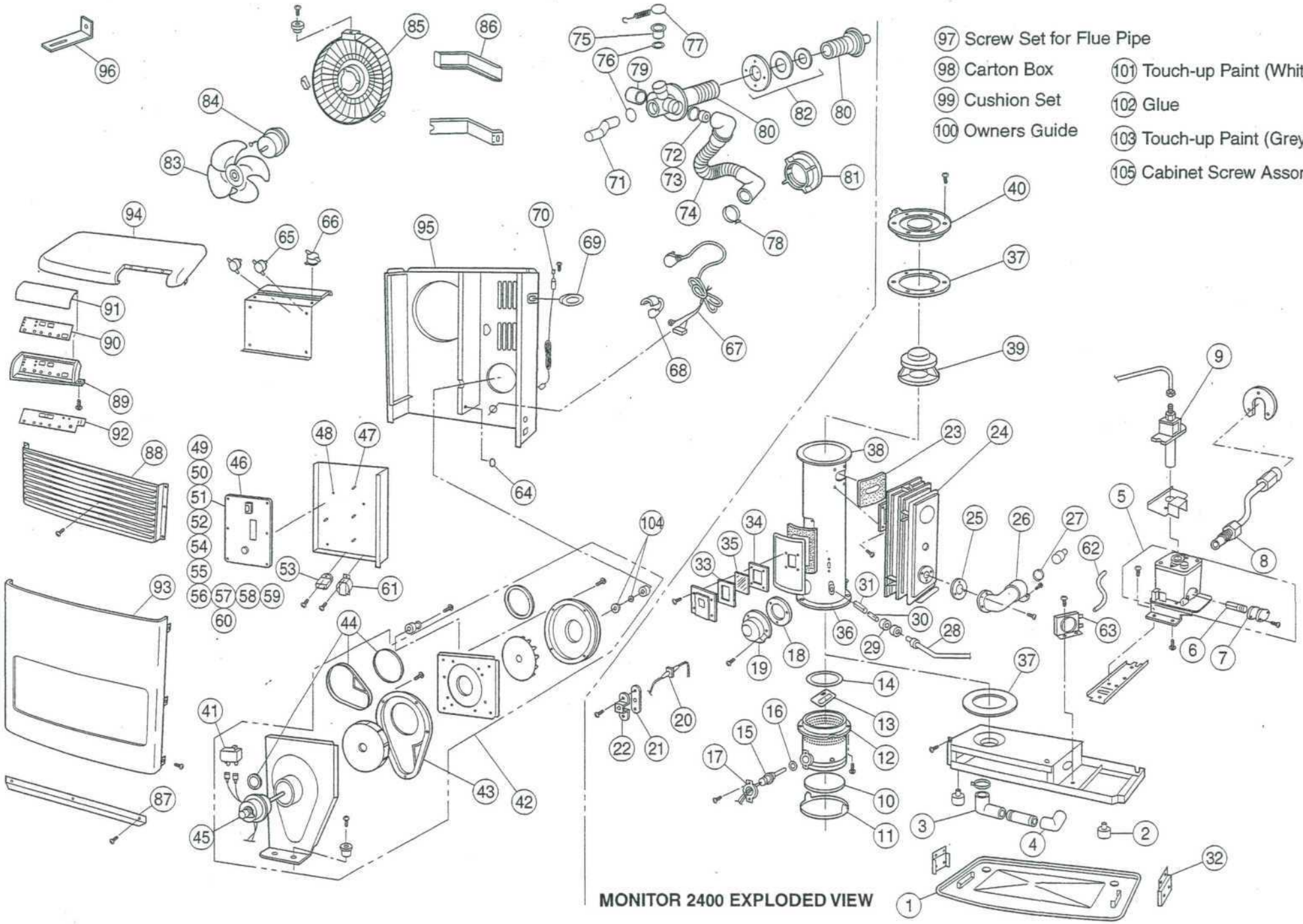


Figure 7-2 Monitor 2200

MONITOR 2400 SERVICE PARTS LIST

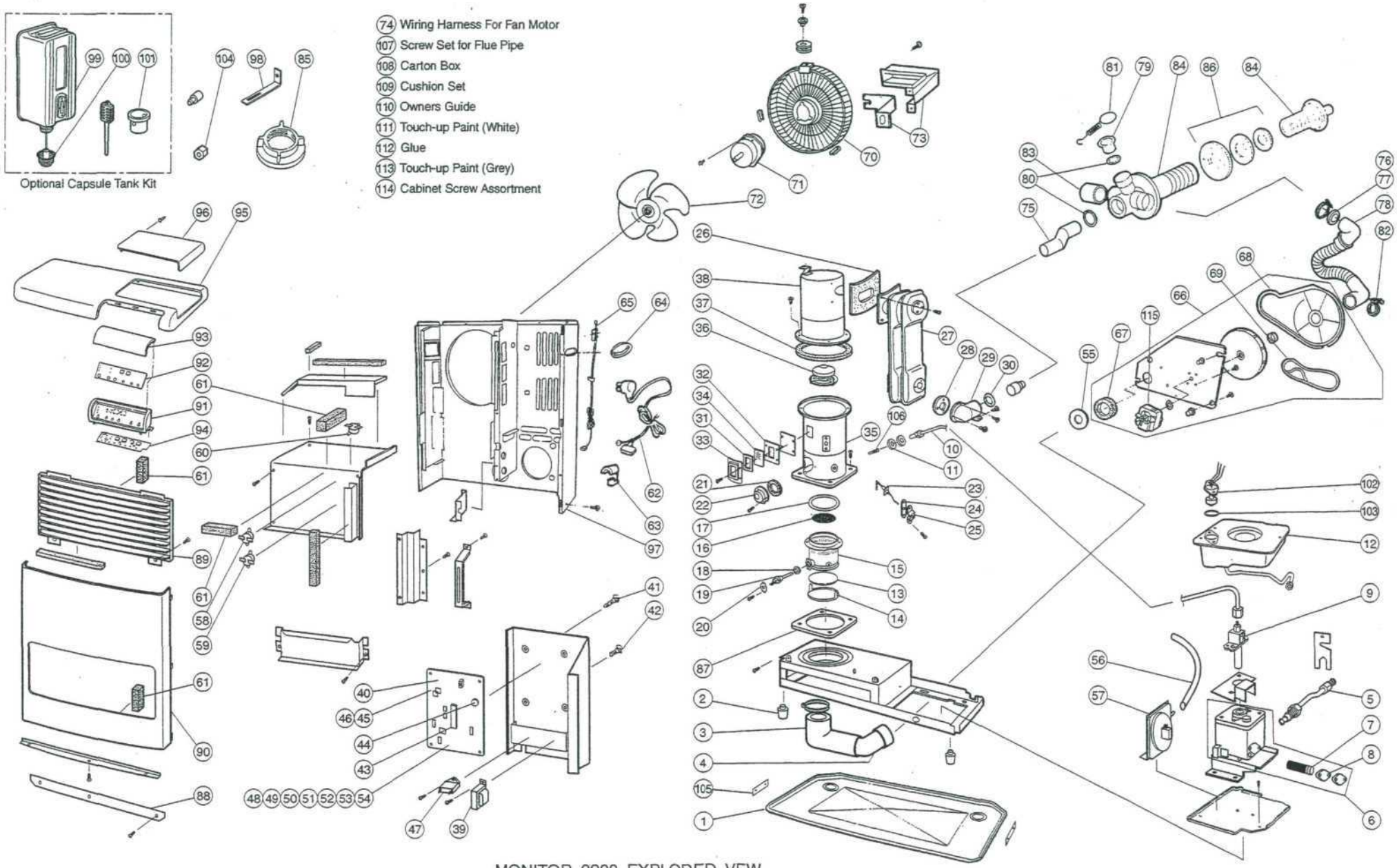
ITEM NO.	PART NO.	DESCRIPTION	ITEM NO.	PART NO.	DESCRIPTION
1	6724	SPILL TRAY	55	6254	RELAY RL1(For Reference Only)
2	5019	ADJUSTABLE LEG	56	6255	TRIAC(Q1)(For Reference Only)
3	6301	AIR SUPPLY HOSE(A)	57	6257	PHOTO TRIAC(IC3)(For Reference Only)
4	6302	AIR SUPPLY HOSE(B)	58	6700	PHOTO TRIAC(IC4)(For Reference Only)
5	6469	Constant level valve only 1998 441/422	59	6701	PHOTO TRIAC(IC5)(For Reference Only)
6	6470	C.L.V. strainer 1998 441/422	60	6204	PHOTO COUPLER(IC6)(For Reference Only)
7	6471	Strainer gasket 1998 441/422	61	6702	POWER TRANSFORMER
8	6725	FUEL PIPE	62	6326	AIR LINE
9	6726	SOLENOID PUMP	63	6703	AIR PRESSURE SWITCH
10	6357	GASKET(1)	64	6136	RUBBER BUSHING
11	6357A	GASKET(1) RETAINING PLATE	65	6704	OVER HEAT THERMOSTAT
12	6401	BURNER	66	6705	FAN THERMOSTAT
13	6363	BURNER CLOTH	67	6706	POWER SUPPLY CORD
14	6358	ROPE GASKET	68	4833	CORD BUSHING
15	6311	HEATER(IGNITER)	69	6707	CARRYING HANDLE
16	6115	GASKET(3)	70	6708	SENSOR ASSY
17	6402	IGNITER BRACKET	71	4004	JOINT PIPE
18	6354	HEATER COVER PACKING	72	6407	AIR DAMPER(E)
19	6403	IGNITER COVER	73	6408	AIR DAMPER(S)
20	6355	FLAME DETECTIVE PLUG	74	6145	AIR SUPPLY HOSE ASSY
21	6119	PLUG PACKING	75	4014	EXHAUST OUTLET CAP
22	6196	FL PLUG BRACKET	76	4016	AIR PORT O RING
23	6313	GASKET(4)	77	4006	PIPE HOLDER
24	6314	HEAT EXCHANGER ASSY	78	4008	HOSE BAND
25	6122	GASKET(6)	79	4805	AIR OUTLET CAP
26	6123	EXHAUST DUCT	80	8050	FLUE PIPE A/B
27	6176	O-RING(P39)	81	6723A	SLEEVE NUT
28	6473	Oil sump pipe 1998 M441	82	6148	SLEEVE FLANGE SET
29	6164	JOINT SEAL PACKING	83	6075	FAN BLADE
30	6352	FUEL NOZZLE	84	6709	CIRCULATION MOTOR
31	6353	FUEL NOZZLE COVER	85	6710	BLOWER GUARD
32	6404	BASE TRAY RETAINER	86	6455	WIRING GUARD
33	6124	WINDOW GASKET	87	6711	UNDER COVER
34	6125	WINDOW FRAME GASKET	88	6712	LOUVER
35	6405	WINDOW GLASS	89	6713	PLASTIC BUTTON PANEL
36	6350	WINDOW BASE GASKET	90	6714	LAMP PANEL
37	6317	CHAMBER GASKET	91	6715	CONTROL COVER
38	6349	COMBUSTION CHAMBER ASSY	92	6716	SWITCH & LAMP ASSY
39	6356	COMBUSTION RING ASSY	93	6717	FRONT COVER
40	6321	CHAMBER CAP	94	6718	TOP COVER
41	6727	CAPACITOR(3.0μF)	95	6719	CABINET ASSY
42	6728	COMBUSTION BLOWER ASSY	96	6194	WALL CLAMPS
43	6729	SUCTION CASE A ASSY	97	6197	SCREW SET FOR FLUE PIPE
44	6144	SEAL PACKING	98	6720	CARTON BOX
45	6730	MOTOR FOR COMBUSTION	99	6721	CUSHION SET
46	6731	PWB ASSY	100	1157	OWNERS GUIDE
47	6461	PWB SPACER CLIP(A)	101	8216	TOUCH-UP PAINT(WHITE)
48	6462	PWB SPACER CLIP(B)	102	8217	GLUE
49	6732	MICROPROCESSOR	103	6722	TOUCH-UP PAINT(M2400 GREY)
50	6733	BUZZER	104	6348A	Combustion Blower Assy Nut and Retaining Washer
51	6172	FUSE(250V, 10A)			
52	6173	FUSE(250V, 2A)	105	6735	Cabinet Screw Assortment
53	6734	FAN CAPACITOR(1.5μF)(For Reference Only)			
54	6187	TR ARRAY(M54563P) IC10(For Reference Only)			



MONITOR 2400 EXPLODED VIEW

MONITOR 2200 SERVICE PARTS LIST

ITEM NO.	PART NO.	DESCRIPTION
1	6740	SPILL TRAY
2	5019	ADJUSTABLE LEG
3	6741	AIR SUPPLY HOSE(A)
4	6102	AIR SUPPLY HOSE(B)
5	6742	FUEL PIPE
6	6469	CONSTANT LEVEL VALVE only 1998 441/422
7	6470	C.L.V. STRAINER 1998 441/422
8	6471	STRAINER GASKET 1998 441/422
9	6744	SOLENOID PUMP
10	6745	OIL SUMP PIPE
11	6164	JOINT SEAL PACKING
12	6746	FUEL SUMP
13	6747	GASKET(1)
14	6748	GASKET(1)RETAINING PLATE
15	6749	BURNER
16	6750	BURNER CLOTH
17	6358	ROPE GASKET
18	6115	GASKET(3)
19	6277	HEATER(IGNITER)
20	6402	IGNITER BRACKET
21	6117	HEATER COVER PACKING
22	6191	IGNITER COVER
23	6751	FLAME DETECTIVE PLUG
24	6119	PLUG PACKING
25	6196	FL PLUG BRACKET
26	6120	GASKET(4)
27	6752	HEAT EXCHANGER ASSY
28	6122	GASKET(6)
29	6123	EXHAUST DUCT
30	6176	O-RING(P39)
31	6124	WINDOW GASKET
32	6125	WINDOW FRAME GASKET
33	6786	WINDOW PLATE
34	6069	WINDOW GLASS
35	6753	BURNER CHAMBER ASSY
36	6754	COMBUSTION RING ASSY
37	6130	CHAMBER GASKET
38	6755	COMBUSTION CHAMBER ASSY
39	6702	POWER TRANSFORMER
40	6756	PWB ASSY
41	6134	PWB SPACER CLIP(A)
42	6135	PWB SPACER CLIP(B)
43	6757	MICROPROCESSOR
44	6733	BUZZER
45	6172	FUSE(250V,10A)
46	6173	FUSE(250V,2A)
47	6901	FAN CAPACITOR(1.8uF)(For Reference Only)
48	6187	TR ARRAY(M54563P)IC10(For Reference Only)
49	6254	RELAY RL1(For Reference Only)
50	6255	TRIAC(Q1)(For Reference Only)
51	6257	PHOTO TRIAC(IC3)(For Reference Only)
52	6700	PHOTO TRIAC(IC4)(For Reference Only)
53	6701	PHOTO TRIAC(IC5)(For Reference Only)
54	6204	PHOTO COUPLER(IC6)(For Reference Only)
55	6758	BLOWER DAMPER
56	6819	AIR LINE A
57	6703	AIR PRESSURE SWITCH
58	6759	OVER HEAT THERMOSTAT A
59	6761	OVER HEAT THERMOSTAT B
60	6762	FAN THERMOSTAT
61	6763	AIR PACKING SET
62	6706	POWER SUPPLY CORD
63	4833	STRAIN RELIEF BUSHING
64	6707	CARRYING HANDLE
65	6708	SENSOR ASSY
66	6764	COMBUSTION BLOWER ASSY
67	6141	BLOWER MOUTH PACKING
68	6766	SUCTION CASE
69	6144	SEAL PACKING
70	6261	BLOWER GUARD
71	6767	CIRCULATION MOTOR
72	6768	FAN BLADE
73	6263	WIRING GUARD
74	6769	WIRING HARNESS FOR FAN MOTOR
75	4004	VENT CONNECTOR
76	6209	AIR DAMPER(S)
77	6770	AIR DAMPER(E)
78	6145	AIR SUPPLY HOSE ASSY
79	4014	EXHAUST OUTLET CAP
80	4016	AIR PORT O RING
81	4006	PIPE HOLDER
82	4008	HOSE BAND
83	4805	AIR OUTLET CAP
84	8050	FLUE PIPE A/B
85	6723	SLEEVE NUT
86	6148	SLEEVE FLANGE SET
87	6806	GASKET(7)
88	6771	UNDER COVER
89	6772	LOUVER
90	6773	FRONT COVER
91	6774	PLASTIC BUTTON PANEL
92	6775	LAMP PANEL
93	6776	CONTROL COVER
94	6716	SWITCH&LAMP ASSY
95	6777	TOP COVER
96	6778	FUEL TANK COVER
97	6779	CABINET ASSY
98	6194	BODY CLAMP
99	6760	Optional CAPSULE TANK KIT
100	6179	FUEL TANK CAP
101	6177	OIL FILTER
102	6780	FLOAT SWITCH
103	6781	FLOAT SWITCH PACKING
104	6345	UNION NUT
105	6782	BASE TRAY RETAINER
106	6783	FUEL NOZZLE
107	6197	SCREW SET FOR FLUE PIPE
108	6784	CARTON BOX
109	6785	CUSHION SET
110	1120	OWNERS GUIDE
111	8216	TOUCH-UP PAINT(WHITE)
112	8217	GLUE
113	6722	TOUCH-UP PAINT(M2400 GREY)
114	6735	Cabinet Screw Assortment
115	6765	BLOWER MOTOR



MONITOR 2200 EXPLODED VEW